Department of Energy
Oak Ridge Operations
Weldon Spring Site
Remedial Action Project Office
Route 2, Highway 94 South
St. Charles, Missouri 63303

August 25, 1987

ADDRESSEES

CHEMICAL CHARACTERIZATION REPORT FOR THE WELDON SPRING QUARRY

Enclosed are copies of the final report for the Chemical Characterization Report for Weldon Spring Quarry, Weldon Spring, Missouri.

Please distribute as appropriate throughout your agency.

Sincerely,

R. R. Nelson

R. R. Nelson
Project Manager
Weldon Spring Site
Remedial Action Project

CE-541:Lawver

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DOE/OR/20722-176

Formerly Utilized Sites Remedial Action Program (FUSRAP)
Contract No. DE-AC05-81OR20722

CHEMICAL CHARACTERIZATION REPORT FOR THE WELDON SPRING QUARRY

St. Charles County, Missouri

August 1987

Bechtel National, Inc.

DOE/OR/20722-176

CHEMICAL CHARACTERIZATION REPORT FOR THE WELDON SPRING QUARRY ST. CHARLES COUNTY, MISSOURI

AUGUST 1987

Prepared for

UNITED STATES DEPARTMENT OF ENERGY

OAK RIDGE OPERATIONS OFFICE

Under Contract No. DE-AC05-81OR20722

By

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Bechtel National, Inc.

Oak Ridge, Tennessee

Bechtel Job No. 14501

ABSTRACT

The Weldon Spring Site (WSS) in St. Charles County, Missouri, is a U.S. Department of Energy (DOE) surplus facility comprised of the Weldon Spring Quarry (WSQ), raffinate pits, chemical plant, and vicinity properties. Characterization of the WSQ was conducted in two phases. The first phase of the quarry characterization was performed in 1984 and 1985 and consisted primarily of radiological analysis of surface soils, subsurface soils, surface water, and groundwater samples. A few samples were analyzed for chemical parameters and the resulting data were used in planning Phase 2 chemical characterization activities.

This report describes the second phase of the WSQ characterization for chemical constituents including the procedures used to conduct the characterization and the analytical results. The results indicated elevated (relative to background) concentrations of semi-volatiles, PCBs, and nitroaromatics in soil and sediment. Volatiles were also observed in elevated concentrations; however, their presence in method and field blanks suggests the inadvertent introduction of these chemicals during field collection or laboratory extraction.

Given the physical-chemical characteristics of the detected chemicals, sorption to soil will limit the movement of PCBs and semi-volatiles into groundwater and surface water. Nitroaromatics may be more likely to move into these media. Volatiles, if present, will have a greater possibility than PCBs, semi-volatiles, or nitroaromatics to move into the groundwater and surface water.

The horizontal and vertical distribution of chemicals is similar to the distribution of radionuclides reported in the Phase 1 characterization report. The volume of the WSQ fill material is estimated to be 107,000 yd^3.

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ABBREVIATIONS

DL	detection limit
l	liter
mi	mile
ppm	parts per million
ug/kg	micrograms per kilogram
ug/l	micrograms per liter
yd^3	cubic yards

1.0 INTRODUCTION

1.1 BACKGROUND

The Weldon Spring Site (WSS) is a U.S. Department of Energy (DOE) surplus facility located in St. Charles County, Missouri. The site is comprised of three separate facilities, approximately 4 mi apart, and their surrounding vicinity properties. The three facilities are the 52-acre raffinate pits facility, the adjoining 169-acre chemical plant, and the 9-acre Weldon Spring Quarry (WSQ).

Presently, the raffinate pits and the WSQ are used for the storage of residual radioactive residues, waste materials, and contaminated rubble. The chemical plant is a non-operational uranium feed materials plant. DOE is also responsible for vicinity properties near the raffinate pits, chemical plant, and WSQ that became contaminated as a result of operations at the facilities.

During October through December 1984 and May 1985, a radiological and limited chemical characterization of the quarry was conducted by Bechtel National, Inc. (BNI) and Eberline Analytical Corporation (EAC), presently known as Thermoanalytical/Eberline (TMA/E), (Ref. 1). It was determined that much of the fill material of the quarry was contaminated with residual radioactive compounds. The results also showed that radioactive materials were comingled with low levels of various chemical compounds. Upon review of the data by the Environmental Protection Agency (EPA) Region 7, it was decided that additional information concerning the chemical composition of the waste was needed to make a determination of its status.

The survey of the WSQ described in this document represents the second phase of the site characterization. The plan was developed with the guidance of EPA Region 7. The survey was conducted by BNI and TMA/E during the period from October through December 1986. The analyses of the samples were completed by TMA/Norcal.

1.2 PURPOSE AND OBJECTIVE

The chemical characterization survey was performed to provide additional information about the types and distribution of chemical contaminants in the WSQ fill. This information was needed to determine the waste's status and to aid in preparing remedial action plans for the WSQ.

The sampling and analysis were designed to determine the presence and areal extent of selected chemical compounds including volatile organics, base-neutral and acid extractable organics (semi-volatiles), trinitrotoluene (TNT), dinitrotoluene (DNT), and TNT breakdown products in soil and sediment. These compounds were selected based upon their suspected presence in materials deposited in the WSQ.

2.0 SITE BACKGROUND AND DESCRIPTION

A brief history of the WSQ and a description of its present condition are provided in this section.

2.1 SITE HISTORY

The WSQ was a limestone and sand quarry that was previously part of the Department of the Army's Weldon Spring Ordnance Works. It was used during the 1940s for disposal of rubble contaminated with TNT (Ref. 2). In 1958, the Atomic Energy Commission acquired title to the property and took possession of the site from the Army. In 1959, the WSQ was used to store an estimated 200 yd^3 of 3.8 percent thorium residues (in drums).

In 1963 and 1964, portions of the Mallinckrodt Chemical Works' Destrehan Street Feed Materials Plant in St. Louis were demolished. An estimated 50,000 yd^3 of uranium- and radium-contaminated building rubble, equipment, and soils were deposited in the WSQ (Ref. 3).

In 1966, an estimated 600 yd^3 of drummed and bulk 3 percent thorium residues were deposited in the WSQ. Later that year, these residues were covered with an unspecified volume of TNT-contaminated rubble (Ref. 4).

In 1968, the Army decontaminated several buildings at the Weldon Spring Chemical Plant (WSCP). This activity produced an estimated 6,000 yd^3 of uranium- and thorium-contaminated building rubble and unrecoverable processing equipment which were disposed of in the WSQ (Refs. 4 and 5). In 1976 and 1977, geological, hydrological, and radiological investigations of the WSQ were made for DOE by National Lead Company of Ohio (Ref. 6). Subsequently, as part of the overall assessment of the WSQ and planning for its disposition, DOE requested the Berkeley Geosciences Associates to perform characterization and assessment work. This took place from 1979 to

1981 (Ref. 2). A more detailed description of the history of the WSQ is documented in Reference 2.

During 1984 and 1985, BNI and EAC performed a radiological characterization, with limited chemical sampling, of the quarry soils and fill material to determine the vertical and areal extent of radiological contamination. From the data obtained it was estimated that 95,000 yd^3 of materials at the quarry are contaminated in excess of DOE radiological guidelines. After the 1985 review of the initial chemical characterization data from the quarry, Region 7 of the EPA requested additional chemical sampling of the quarry soil/rubble.

2.2 LOCATION AND DESCRIPTION

The WSQ is approximately 30 mi west of downtown St. Louis, Missouri. It is roughly 1 mi northwest of the Missouri River, and 4 mi southwest of the WSCP and the raffinate pits facility, as shown in Figure 2-1.

The WSQ is in an area of rugged topography, as illustrated in Figure 2-2. Most of the adjacent lands are used for recreational purposes. A well field supplying the St. Charles County Waterworks is located 0.75 mi southeast of the site. An abandoned railroad spur enters the lower level and extends into the quarry. A plan view of the WSQ is shown in Figure 2-3. Figure 2-4 is an aerial photograph of the site and its immediate environs.

The WSQ is protected from casual entry by a 7-ft-high chain link fence topped with barbed wire. Access to the site is provided by a gravel road from Route 94 to the quarry floor, and through a security gate on the upper level adjacent to Route 94.

The WSQ is essentially a closed basin. At the bottom, a pond covers about 0.5 acre, containing approximately 3,000,000 gallons of water up to 20 ft deep (Ref. 7). The amount of water in the pond varies with seasonal precipitation and temperature.

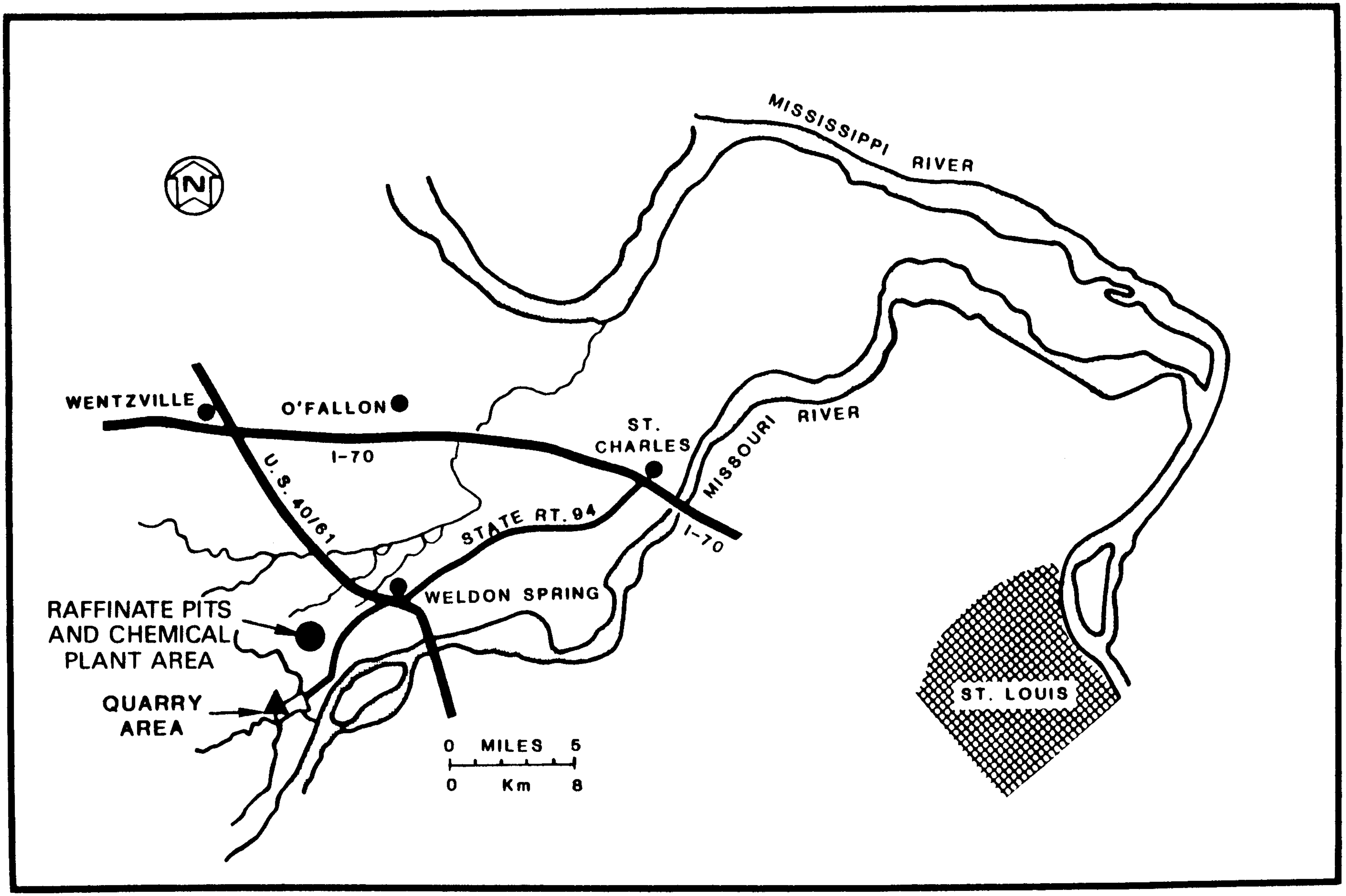
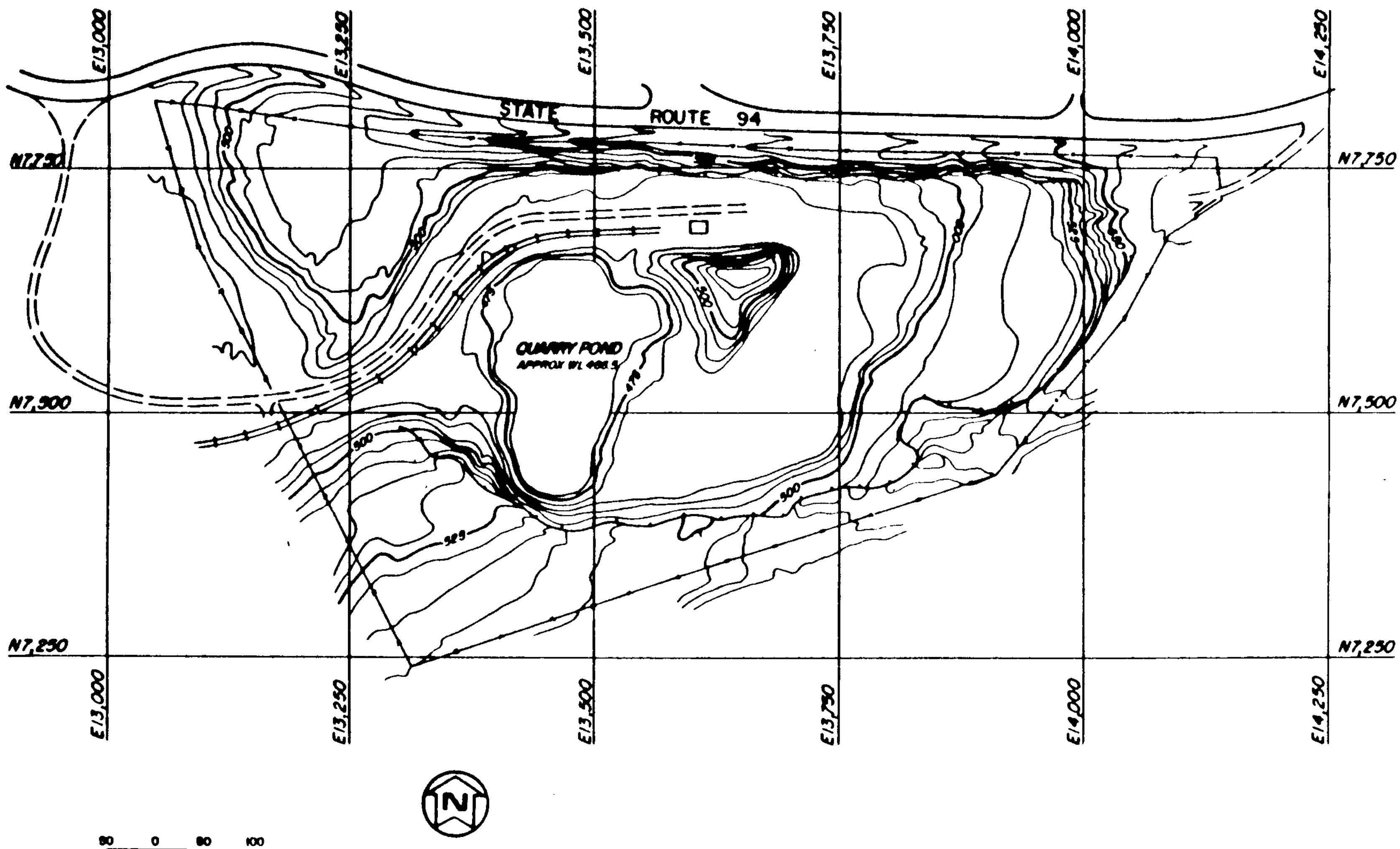


FIGURE 2-1 LOCATION OF THE WSQ



CONTOUR INTERVAL 5 FT SOURCE: DABER ENGINEERING CORPORATION

FIGURE 2-2 TOPOGRAPHIC MAP OF THE WSQ

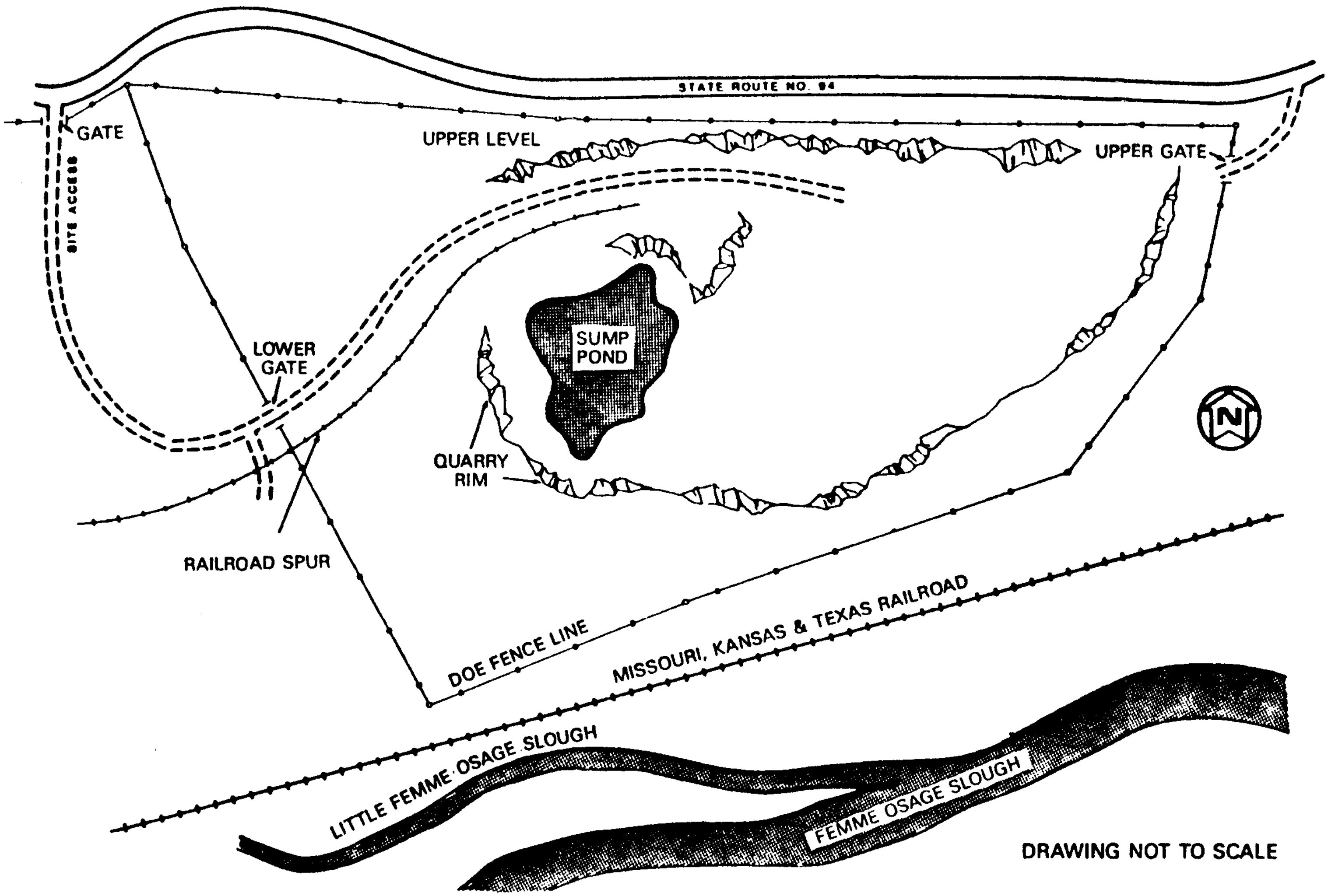


FIGURE 2-3 PLAN VIEW OF THE WSQ

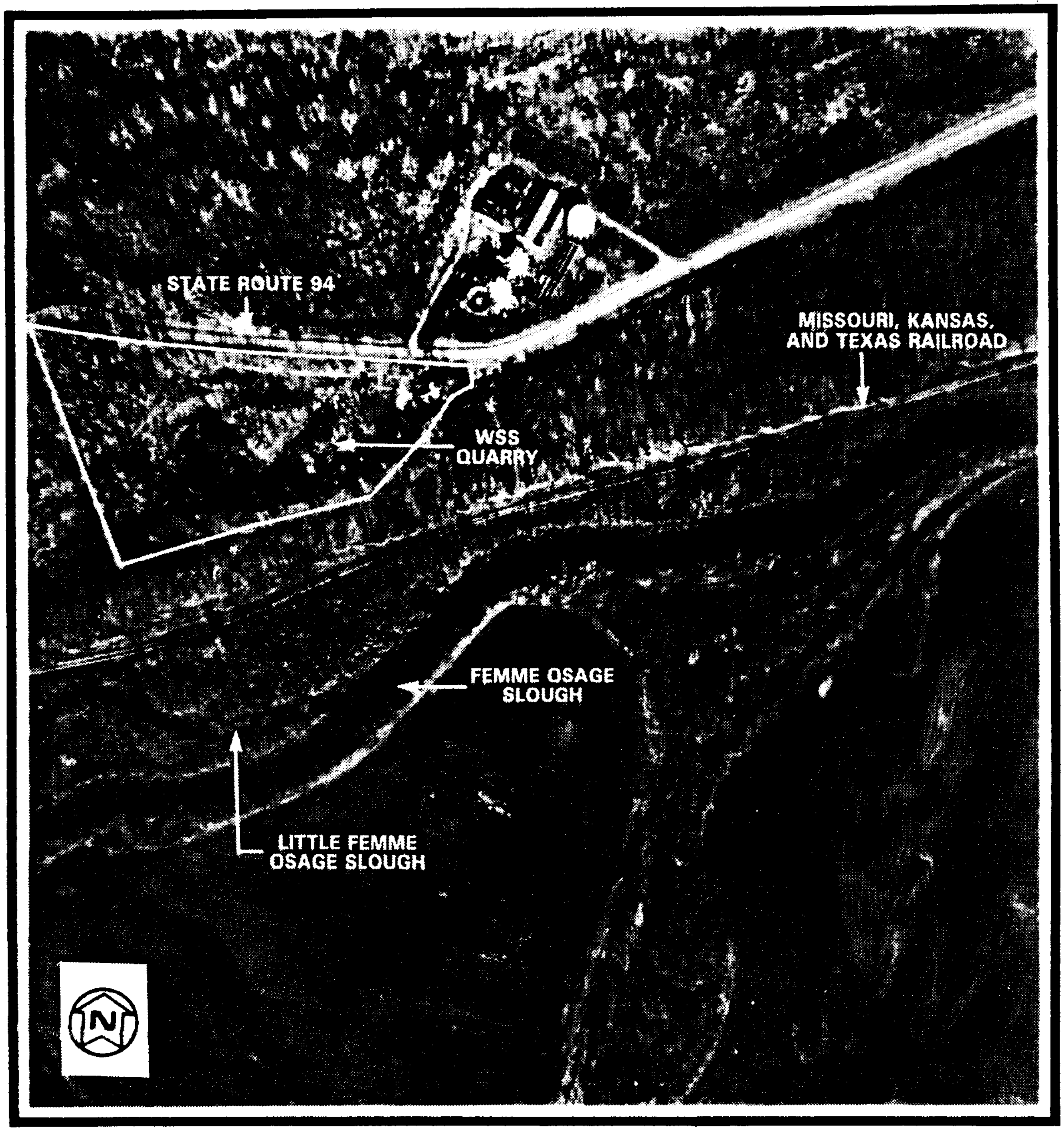


FIGURE 2-4 AERIAL VIEW OF THE WSQ

3.0 HEALTH AND SAFETY PLAN

BNI is responsible for the health protection of personnel assigned to work at the site. As such, during characterization work, all subcontractors and their personnel were required to comply with the provisions of the applicable project instructions cited in this section or as directed by the on-site BNI representative.

3.1 SUBCONTRACTOR TRAINING

Before the start of work, all subcontractor personnel attended an orientation session presented by the BNI representative to explain the nature of the material to be encountered in the work and the required personnel monitoring and safety measures.

3.2 SAFETY REQUIREMENTS

Subcontractor personnel complied with the following BNI requirements.

- Bioassay - Subcontractor personnel submitted bioassay samples before or at the beginning of on-site activity, upon completion of the activity, and periodically during site activities as requested by BNI.

- Protective Clothing/Equipment - Subcontractor personnel wore the protective clothing/equipment specified in the subcontract or as directed by the BNI representative.

- Dosimetry - Subcontractor personnel were required to wear, and return daily, the dosimeters and monitors issued by BNI.

- Controlled Area Access/Egress - Subcontractor personnel and equipment entering areas wherein access and egress are controlled for radiation and/or chemical safety purposes were surveyed by the BNI representative for contamination before leaving those areas.

- Medical Surveillance - Upon written direction from BNI, subcontractor personnel, who worked in areas where hazardous chemicals may exist, were given a baseline and periodic health assessment defined in BNI's Medical Surveillance Program.

Radiation and/or chemical safety surveillance of all activities related to the scope of work was under the direct supervision of personnel representing BNI.

The health physics requirements for all activities involving radiation or radioactive material are defined in Project Instruction No. 20.01, the Project Radiation Protection Manual, and implementing procedures.

The industrial hygiene requirements for activities involving chemicals or chemically contaminated materials are defined in Project Instruction No. 26.00, the Environmental Hygiene Manual, and implementing procedures.

Copies of these project instructions were located on-site for subcontractors' use.

Environmental hygiene monitoring was conducted during drilling operations with an ENMET CGS-100.

4.0 SAMPLE COLLECTION AND ANALYSIS PROCEDURES

The following subsections describe the methods used to collect and analyze samples.

4.1 CIVIL SURVEY

During Phase 1 of the site characterization (1984 and 1985), a civil surveyor established the survey grid system for the site. The grid was tied to U.S. Geological Survey Benchmark (BM465) located south of the WSQ. The grid consisted of perpendicular lines spaced 50 ft apart, as shown in Figure 4-1. The same grid was used for Phase 2 work.

4.2 SELECTION OF BOREHOLE LOCATIONS

The selection of borehole locations was a cooperative effort between Region 7 of EPA and DOE. Selection of borehole locations was based on historical data including types of materials disposed, disposal locations, past characterization data, and topography. Seventeen borehole locations and five sediment sampling locations, as shown in Figure 4-1, were selected. Table 4-1 lists the borehole coordinates, depths, and final sample intervals. The completed boreholes were placed within 5 ft of the selected locations unless otherwise noted.

4.3 BOREHOLE DRILLING TECHNIQUES

Hollow stem augering was used previously during Phase 1 to collect borehole samples. This technique proved to be ineffective because of concrete rubble and other obstructions in the landfill (Ref. 1).

As a result of the Phase 1 experience, an alternative drilling method was used during Phase 2. This technique used a double tube core barrel that was capable of drilling through obstructions while retaining a relatively undisturbed sample. Water from a hydrant north of Building 103 at the WSCP was stored in a tank at the WSQ

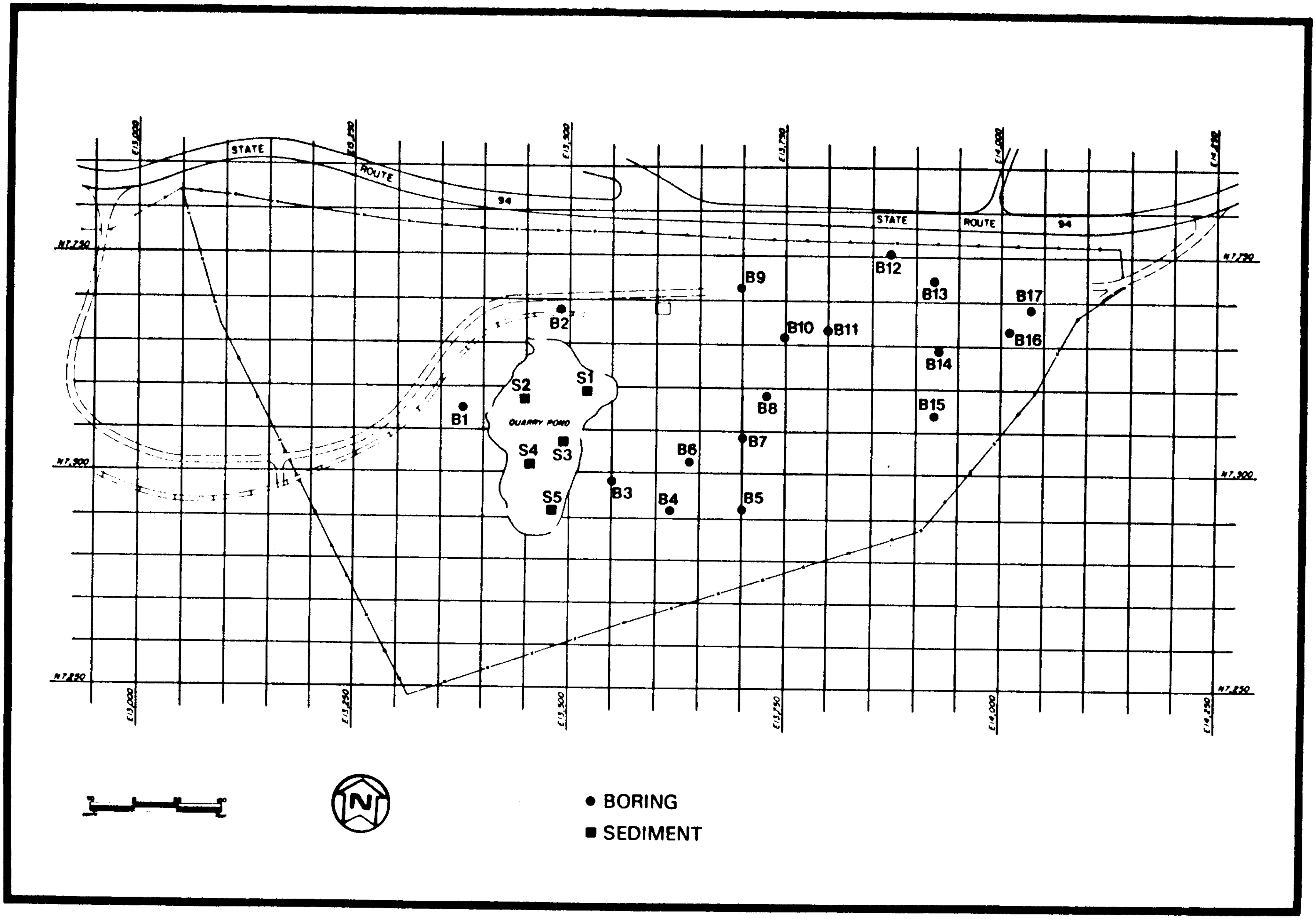


FIGURE 4-1 SAMPLING LOCATIONS AT THE WSQ

TABLE 4-1

BOREHOLE COORDINATES, DEPTHS, AND FINAL SAMPLING INTERVALS

Hole Designator	Coordinates East	Coordinates North	Total Depth of Hole	Final Sample Interval(1)
B-1	E13375	N07575	2.0	0 - 1
B-2	E13495	N07685	6.0	3 - 4
B-3	E13550	N07490	36.8	33 - 35
B-4	E13610	N07465	39.5	6 - 9
B-5	E13700	N07465	34.0	30 - 32
B-6	E13640	N07515	37.5	33 - 36
B-7	E13700	N07540	40.5	36 - 38
B-8	E13730	N07590	31.0	6 - 9
B-9	E13700	N07710	3.5	0 - 2
B-10	E13750	N07655	3.0	0 - 1
B-11	E13800	N07660	6.0	0 - 3
B-12	E13875	N07750	6.5	3 - 5
B-13	E13925	N07720	10.2	7 - 8
B-14	E13930	N07645	12.1	3 - 6
B-15	E13925	N07570	10.8	6 - 9
B-16	E14014	N07667	30.5	27 - 29
B-17	E14040	N07690	25.5	24 - 25

(1) Deepest interval from which samples were collected.

and was introduced into the borehole to cool and lubricate the bit. As a result, some leaching of chemicals from the solid soil matrix may have occurred.

This drilling technique was reviewed by EPA Region 7 prior to the start of drilling operations and during drilling operations in the field. It was concluded in both reviews that the drilling technique was the most reasonable, based on the drilling conditions and the large amount of rubble encountered. All boreholes were closed after sample collection by tremie-grouting with bentonite cement.

4.4 SAMPLE COLLECTION

4.4.1 Sediment Collection

Sediment samples from the quarry pond were collected using a Ponar Grab Sampler. The Ponar Grab Sampler is a clam shell scoop activated by a counter lever system. The sampler is opened and latched in place, and then slowly lowered to the bottom of the pond. When the sampler is on the bottom, the tension is released on the lowering cable, the latch releases, and the lifting action of the cable on the lever system closes the sampler clam shell. The sampler is brought to the surface where the sample is removed and placed in the appropriate sample bottle.

4.4.2 Subsurface Sample Collection

Continuous samples were collected from all boreholes. Only those portions of the samples that were soil or soil-like materials were analyzed. Geologic borehole logs in Appendix A provide information on stratification and materials encountered during drilling.

The downhole drilling tools used to sample the materials disposed of within the WSQ were selected for their ability to penetrate a multitude of solid waste types. The quarry fill was known to contain a wide variety of materials including steel, concrete, wood, rubber, and soil.

Split spoons were the preferred method of sample collection. If rubble was encountered, sample collection was accomplished using the double tube core barrel. The double tube core barrel was chosen over the triple tube core barrel for its extra stiffness and simpler construction, when it became apparent that the majority of the wastes consisted of materials that would be retained.

The bit type used for all drilling was either a diamond set, hard matrix, or a diamond impregnated core bit. Potable water was used for bit cooling and cuttings removal. A sample of the potable water was analyzed (for a description of the findings, see subsection 5.2, page 48).

Drilling at some locations was extremely difficult due to buried rubble. At borehole B3, for instance, 2 days of drilling and the expenditure of three diamond bits achieved an advance of less than 3 in. As a result, drilling was discontinued and the hole was closed. Another location, approximately 5 ft from the original hole, was selected and successfully advanced.

For split spoon sample collection, the spoon was first removed from the hole and then opened to provide access to the sample. When the double tube core barrel was used, the inner barrel was removed. The barrel holding the sample was designed to open longitudinally to provide access to the sample.

An undisturbed sample for volatile organics analyses was collected prior to collection of samples for other analyses. The sample was placed into a 40-ml volatile organic compound sample vial with a teflon septum.

Volatile organics samples were collected from a minimum of 30 percent of each 3-ft increment of samples. After collection of volatile organics samples, each remaining 1-ft section of sample was placed in one or more 1-liter glass jars with teflon lids.

Chain-of-custody forms were completed for each shipment of samples. All sample containers were securely packaged in sturdy ice chests for shipment to the analytical laboratory. Frozen blue ice packs were placed in each ice chest, and all void space was filled with bubble wrap. Samples were shipped to the laboratory on a daily basis.

Coring tools were decontaminated prior to use in each borehole to prevent cross-contamination of the samples. The split spoons and inner barrel of the double tube core barrel were decontaminated prior to use for each sample to prevent cross-contamination of the samples. Decontamination included washdown with high pressure water and steam, followed by a distilled water rinse. If oil or an oily substance was noted, an methyl alcohol rinse was included between the steam cleaning and distilled water rinse. Decontamination was confirmed by visual inspection of the equipment to ensure that any oil or oily substances had been removed. Methyl alcohol was chosen as the solvent to be used in decontamination efforts at the direction of EPA Region 7 personnel.

4.5 SAMPLE ANALYSES

The volatile organics, semi-volatile organics, and PCBs analyses were performed in accordance with the EPA Contract Laboratory Program (CLP) (Ref. 8). The nitroaromatics analyses were performed according to the U.S. Army Toxic and Hazardous Materials Agency Method 4B, using high pressure liquid chromatography.

4.6 QUALITY CONTROL

During the WSQ characterization, Quality Control (QC) measures were implemented for the field activities and the analytical procedures. The QC measures for the field included the following:

- o A site characterization plan describing sampling locations, sampling procedures, and analytical procedures.
- o Documentation of field measurements.

- o Documentation of field activities.

- o Documentation of sample chain-of-custody.

- o Generation of QC samples including blanks and duplicates.

The analytical QC procedures included those consistent with CLP protocol, such as the following:

- o Method blanks
- o Field blanks
- o Matrix spikes
- o Matrix spike duplicates

Blanks are artificial samples designed to monitor the introduction of artifacts into the analytical process. Blanks are carried through the entire analytical scheme from extraction through concentration and analyses.

A method blank is an aliquot of analyte-free water or solvent analyzed with the analytical batch. Field blanks are aliquots of analyte-free water or solvents brought to the field in sealed containers and transported back to the laboratory with the sample containers.

Matrix spikes and matrix spike duplicates are samples used to evaluate analytical accuracy and precision, respectively. In matrix spike and matrix spike duplicate analyses, predetermined quantities of stock solutions of certain analytes are added to a sample matrix. The resulting matrix spike is split and both samples (i.e., the matrix spike and matrix spike duplicate) are extracted and analyzed. Accuracy is evaluated by comparing the results of the matrix spike analyses with the known concentration of analyte in the spike. Precision is evaluated by comparing the results for both the matrix spike and the matrix spike duplicate. Relative Percent

Difference (RPD) is commonly used to express analytical precision and is defined as:

$$RPD = \frac{R_1 - R_2}{(R_1 + R_2)/2} \times 100$$

where:

R_1 = the value of the recovery of the matrix spike
R_2 = the value of the recovery of the matrix spike duplicate

The greater the RPD, the less precise is the analytical process. The results for analytical QC are discussed in Section 5.1.

5.0 CHARACTERIZATION RESULTS

Analytical results for the Phase 2 characterization are summarized and discussed in the following subsections. A complete set of analytical results were transmitted to DOE under separate cover (Ref. 9).

5.1 DATA QUALITY

The quality of the analytical data was evaluated by reviewing the results for the QC tests described in Subsection 4.6. These results are described in the following paragraphs.

The results of field and method blanks analyses are provided in Table 5-1. At least 13 field blanks were analyzed for all of the parameters in the analytical program (i.e., volatiles, semi-volatiles, nitroaromatics, and PCBs). Field blanks were analyzed a minimum of once with every six samples. Semi-volatiles and PCBs were not detected in any field blank; volatiles and nitroaromatics were detected. When considered as a group, five volatile organics including acetone, 2-butanone, ethylbenzene, methylene chloride, and total xylenes and one nitroaromatic, 2,6-DNT, were detected in the field blanks.

At least eight method blanks were analyzed for all of the parameters in the analytical program. Method blanks were analyzed a minimum of once with every 10 samples. Only volatile organics were detected in method blanks including the same volatile compounds detected in the field blanks plus toluene and styrene.

The results for the field and method blanks indicated no contamination by PCBs and semi-volatiles. There were, however, volatiles and nitroaromatics in the field and method blanks. These were introduced as a result of field and laboratory activities. The similarity between the volatile compounds detected in the field and method blanks suggests that contamination of the samples with these compounds occurred. Upon closer review it was noted that the method

TABLE 5-1

BLANK RESULTS

Parameter	Type of Blank	Number of Blanks	Number of Blanks With Contamination(1)
Volatiles	Field	13	12
	Method	19	17
Semi-volatiles	Field	16	0
	Method	12	0
Nitroaromatics	Field	13	4
	Method	10	0
PCBs	Field	15	0
	Method	8	0

(1)At or above the detection limit.

blanks analyzed as low concentration samples contained no contaminants, while the method blanks analyzed as medium level concentration samples all had traces of contaminants. The difference between the analytical procedures is the use of methanol to extract the sample for the medium level concentrations. The most probable source of contaminants in blanks is the methanol used in the analyses.

Table 5-2 shows the range and average of the contamination present in the blanks. In most cases, the ranges and averages of contamination are greater in the method blanks than in the field blanks. When compared among the blanks, the amounts of contamination are similar, with the exception of methylene chloride and acetone.

The results for matrix spike recoveries are shown in Table 5-3. A minimum of six matrix spikes were conducted for each group of parameters in the analytical program. Matrix spikes were analyzed a minimum of once every 10 samples. The recovery values for volatiles and semi-volatiles were within or near the range of values generally accepted as part of the CLP. No generally accepted recovery range is provided by CLP for nitroaromatics; however, the values closely approximate those for volatiles, and are believed to be reasonable for this analysis and matrix.

Poor recovery values were observed for PCBs. The range in recoveries for aroclor 1248 (the spiking compound) was 0 to 3 percent. Low recoveries of PCBs relative to other groups of compounds are common. The unusually low values reported in Table 5-3 are due to matrix interference.

The recovery values for volatiles, semi-volatiles, and nitroaromatics generally indicate acceptable analytical accuracy. The low recovery values for PCBs suggests a matrix which complicates interpretation of the results for these compounds. The detection limits varied greatly between samples. This information raised the

TABLE 5-2

CONTAMINATION OF BLANKS

	Method Blanks (ug/kg)		Field Blanks (ug/kg)	
	Range	Average[1]	Range	Average[1]
Methylene Chloride	5-7,400	2,100	500-12,000	3,800
Acetone	10-3,200	3,400	990-25,000	10,000
2-Butanone	10-1,200	1,100	990-1,000	1,000
Toluene	5-1,100	820	ND[2]	NA[3]
Ethylbenzene	5-1,100	830	500-1,000	770
Styrene	5-550	550	ND	NA
Total Xylenes	5-1,400	920	490-1,400	920
2,6-Dinitrotoluene	ND	NA	0.046-4.30[4]	3.1[4]

(1) Average of those above detection limit.
(2) None above detection limit.
(3) Not applicable.
(4) Units = ug/l.

TABLE 5-3

MATRIX SPIKE RESULTS

Parameter	Number of Analyses	Range of Recoveries (%)	Mean of Recoveries (%)	Range of Accepted Recovery[1] (%)
Volatile	6	26 - 133	96	59 - 172
Semi-volatile	7	9 - 128	68	17 - 142
Nitroaromatic	8	20.9 - 127.2	88.8	(2)
PC		0 - 3[3]	1[3]	(2)

(1) Ref. 8.

(2) None currently established.

(3) This value was calculated using 5 samples since 3 were out of control due to the low concentration of the spike compared to the concentration in the sample.

possibility that PCBs were present, but they were not detected by the analytical method.

The results for matrix spike duplicates are shown in Table 5-4. A minimum of six matrix spike duplicates (with the exception of nitroaromatics for which there is no CLP methodology) were analyzed for all of the parameters in the analytical program. Matrix spike duplicates were analyzed a minimum of once every 10 samples. The range of RPDs was least for the volatiles and greatest for the semi-volatiles. The mean RPD within each analytical group ranged from 5 percent for volatiles to 25 percent for PCBs. The RPDs for all groups of compounds in the analytical program generally indicate acceptable analytical precision.

The results for field duplicates are shown in Table 5-5. As a minimum, nine field duplicates were analyzed for all parameters in the analytical program. Field duplicates were analyzed a minimum of once every eight samples.

The range of RPDs was least for the PCBs and greatest for the nitroaromatics. The mean RPDs within each analytical group were similar, ranging from a low of 27 percent for the semi-volatiles to a high of 47 percent for the nitroaromatics. Field duplicates exhibited a level of precision comparable to that observed for the matrix spike duplicates (Table 5-4). In all instances, however, the precision as indicated by the field duplicate results was less than that indicated by the matrix spike duplicate. This difference may have been introduced during preparation of the duplicate in the field and may reflect the inherent non-homogeneity of chemicals in soil and sediment, rather than a real difference in precision.

The holding time for 83 percent of the volatiles, 93 percent of the semi-volatiles, and 100 percent of both nitroaromatics and PCBs were exceeded. These exceeded holding times do not invalidate the usefulness of the data. The EPA CLP documents (Ref. 8) state, "Technical requirements for sample holding times have only been

TABLE 5-4

MATRIX SPIKE DUPLICATE RESULTS

Parameter	Number of Analyses	Range of the RPDs[1] (%)	Mean[2] (%)
Volatiles	6	-17 - +11	5
Semi-volatiles	7	-83 - +72	17
Nitroaromatics	2	-46 - +19	18
PCBs	8	-125 - 0[3]	25[3]

[1] $$\text{RPD} = \frac{(R_1 - R_2)}{(R_1 + R_2)/2} \times 100$$

Where R_1 = The value of the recovery of the matrix spike
R_2 = The value of the recovery of the matrix spike duplicate

[2] $$\text{Mean} = \sum_{i=1}^{N} \left| \frac{\text{RPD}_i}{N} \right|$$

[3] This value was calculated using 5 samples since 3 were out of control due to the low concentration of the spike compared to the concentration in the sample.

TABLE 5-5

DUPLICATES RESULTS

Parameter	Number of Analyses	Range of the RPDs[(1)] (%)	Mean[(2)] (%)
Volatiles	14	-74 - +168	30
Semi-volatiles	9	-33 - +56	27
Nitroaromatics	9	-173 - +81	47
PCBs	9	+8 - +62	35

(1) $\text{RPD} = \dfrac{(R_1 - R_2)}{(R_1 + R_2)/2} \times 100$

Where R_1 = The value of the first analysis
R_2 = The value of the duplicate analysis

(2) $\text{Mean} = \sum_{i=1}^{N} \left| \dfrac{\text{RPD}_i}{N} \right|$

established for water matrices." This indicates that requirements for soils/sediments holding times may change to longer periods, enabling additional samples to meet the requirements.

5.2 CHEMICAL DISTRIBUTION

The following paragraphs describe the distribution of chemicals in soil and sediment at the WSQ. The analytical results for the water introduced into selected boreholes for cooling and bit lubrication are also discussed.

The first step in the assessment of the analytical data was to identify the vertical intervals in which soil samples were analyzed for volatiles, semi-volatiles, nitroaromatics, and PCBs. These data are provided in Table 5-6 and summarized in the following:

Parameter	Number of Boreholes in Which Analyses Were Completed	Total Number of Analyses
Volatiles	8	26
Semi-volatiles	16	68
Nitroaromatics	17	67
PCBs	16	65

A total of five sediment samples were collected. Analyses for semi-volatiles, nitroaromatics, and PCBs were completed for all sediment samples while analyses for volatiles were completed for two samples.

Each compound in the soil and sediment samples that was above the detection limit (DL) is identified in Table 5-7. Also indicated are the frequencies that these compounds were above the DL within each borehole and at each sediment sampling location. Several points are evident from this type of summary:

- seven volatiles in soil and three in sediment were above the DL in eight boreholes and at two sediment sampling locations, respectively, where volatiles were analyzed

TABLE 5-6

SAMPLE ANALYSIS SCHEDULE

Boring	Depth (ft)	Volatiles	Semi-volatiles	Nitro-aromatics	PCBs
B1	0-1		X	X	X
B2	0-3[1]		X	X	X
	2-3[1]	X			
	3-4[1]		X	X	X
B3	0-3		X	X	X
	3-6		X	X	X
	6-9		X	X	X
	8-9	X			
	9-12		X	X	X
	11-12	X			
	27-30[1]		X	X	X
	33-35[1]		X	X	X
B4	0-3		X	X	X
	2-3	X			
	3-6		X	X	X
	6-9[1]		X	X	X
B5	0-3[1]		X	X	X
	6-9[1]		X	X	X
	21-22,23-24[1]		X	X	X
	24-27	X	X	X	X
	27-30		X	X	X
	28-29	X			
	30-31	X			
	30-32		X	X	X
B6	0-1	X			
	1-2	X			
	2-3	X			
	0-3		X	X	X
	3-4	X			
	4-5	X			
	3-6		X	X	X
	6-9		X		X
	15-16	X	X	X	X
	25-26[1]	X			
	29-30[1]	X			
	27-30[1]		X	X	X
	32-33[1]		X	X	X
	33-34[1]	X			
	34-35	X			
	33-36	X	X	X	X

TABLE 5-6

(continued)

Boring	Depth (ft)	Volatiles	Semi-volatiles	Nitro-aromatics	PCBs
B7	0-3	X	X	X	X
	3-6(1)		X	X	X
	6-9(1)		X	X	X
	9-12(1)		X	X	X
	12-15(1)		X	X	X
	13-14(1)	X			
	15-18		X	X	X
	18-21(1)		X	X	X
	19-20	X			
	21-24(1)		X	X	X
	24-27(1)	X	X	X	X
	27-30(1)		X	X	X
	30-33		X	X	X
	33-36		X	X	X
	36-38		X	X	X
B8	0-3		X	X	X
	6-9		X		X
B9	0-2		X	X	X
B10	0-1(1)		X	X	X
B11	0-3(1)			X	
B12	0-3		X	X	X
	3-5		X	X	X
B13	7-8		X	X	X
B14	0-3(1)		X	X	X
	3-6(1)		X	X	
B15	0-3(1)		X	X	
	3-6(1)		X	X	
	6-9(1)		X	X	X
B16	0-3		X	X	X
	3-5		X	X	X
	9-12		X	X	X
	12-15		X	X	X
	15-18		X	X	X
	18-21		X	X	X
	21-24		X	X	X
	24-25(1)	X			
	24-25, 26-27(1)		X	X	X
	27-29(1)		X	X	X

TABLE 5-6

(continued)

Boring	Depth (ft)	Volatiles	Semi-volatiles	Nitro-aromatics	PCBs
B17	0-2		X	X	X
	3-6		X	X	X
	5-6	X			
	6-9		X	X	X
	9-12	X	X	X	X
	12-15		X	X	X
	15-18		X	X	X
	18-21		X	X	X
	21-24	X	X	X	X
	24-25		X	X	X
TW-N	0-3	X	X	X	X
Sediment					
S1	surface		X	X	X
S2	surface		X	X	X
S3	surface	X	X	X	X
S4	surface		X	X	X
S5	surface	X	X	X	X

(1)Part or all of the sample was cored.

TABLE 5-7

PARAMETERS ABOVE AND BELOW THE DETECTION LIMIT (DL) IN SOIL BORINGS AND AT SEDIMENT SAMPLING LOCATIONS AT WHICH ANALYSES WERE COMPLETED

Parameter	At or Above DL		Below DL		Locations at Which Analyses Were Completed	
	Soil	Sediment	Soil	Sediment	Soil	Sediment
<u>Volatiles</u>						
Acetone	6	0	2	2	8	2
2-Butanone	2	0	6	2	8	2
Ethylbenzene	8	2	0	0	8	2
Methylene Chloride	8	2	0	0	8	2
Toluene	1	0	7	2	8	2
Total Xylenes	2	2	6	0	8	2
Trichloroethene	1	0	7	2	8	2
<u>Semi-Volatiles</u>						
Acenaphthene	4	1	12	4	16	5
Dibenzofuran	2	1	14	4	16	5
Fluorene	3	0	13	5	16	5
Phenanthrene	6	1	10	4	16	5
Anthracene	6	1	10	4	16	5
Fluoranthene	6	2	10	3	16	5
Pyrene	6	1	10	4	16	5
Benzo(a)Anthracene	6	1	10	4	16	5
Chrysene	6	1	10	4	16	5
Benzo(b)Fluoranthene	6	2	10	3	16	5
Benzo(k)Fluoranthene	2	0	14	5	16	5
Benzo(a)Pyrene	6	1	10	4	16	5
Indeno(1,2,3-cd)Pyrene	6	1	10	4	16	5
Dibenz(a,h)Anthracene	4	0	12	5	16	5
Benzo(g,h,i)Perylene	6	1	10	4	16	5
2,4-Dinitrotoluene	2	0	14	5	16	5
2,6-Dinitrotoluene	1	0	15	5	16	5
Di-n-butylphthalate	2	0	14	5	16	5
Bis(2-ethyhexyl)Phthalates	3	0	13	5	16	5
Naphthalene	1	1	15	4	16	5
<u>Nitroaromatics</u>						
2,6-Diamino-4-Nitrotoluene	3	0	14	5	17	5
2,4,6-Trinitrotoluene (TNT)	6	1	11	4	17	5
2,4-Diamino-6-Nitrotoluene	2	0	15	5	17	5
2,4-Dinitrotoluene (2,4-DNT)	3	0	14	5	17	5
2,6-Dinitrotoluene (2,6-DNT)	3	0	14	5	17	5
<u>PCBs</u>						
Aroclor 1254	8	1	8	4	16	5
Aroclor 1260	2	0	14	5	16	5

- twenty semi-volatiles in soil and thirteen in sediment were above the DL in nine boreholes and at two sediment sampling locations where semi-volatiles were analyzed

- five nitroaromatics in soil and one in sediment were above the DL in eight boreholes and at one sediment sampling location where nitroaromatics were analyzed

- two PCBs were above the DL in nine boreholes and one sediment sampling location where PCBs were analyzed.

The volatiles detected in sediment and soil include halogenated alkenes, ketones, and aromatics. Methylene chloride and ethylbenzene were detected with the greatest frequency (8 in a total of 8 boreholes). Toluene and trichloroethane were detected with the least frequency (once in a total of 8 boreholes).

The concentration of volatile organics in soil and sediment is summarized in Table 5-8. Concentrations ranged from a high of 52,000 ug/kg for acetone in Boring 6 (depth: 4-5 ft) to a low of 680 ug/kg for total xylenes in the same hole (depth: 33-34 ft). Methylene chloride, ethylbenzene and total xylenes were detected in each of the two sediment samples at maximum concentrations of 12,000, 3,400, and 4,600 ug/kg, respectively.

It is important to note that six of the seven volatile compounds found in soil and sediment were also found in method blanks. Trichloroethane, which was not detected in method blanks, was found in only one sample (B7, depth 13-14 ft) at a concentration of 900 ug/kg. Two volatile organics (methylene chloride and ethylbenzene) also were found at a background location (TW-N) that is not believed to have been influenced by disposal at the WSQ. These observations strongly suggest that the presence of six volatile organics at concentrations above the DL is a laboratory artifact.

Table 5-8 shows which samples have contamination in the associated blanks. All samples show some contamination in the blanks. For ethylbenzene, methylene chloride, and total xylenes, it is noted that the blanks for all samples show contamination which would tend

TABLE 5-8

SUMMARY OF ORGANIC VOLATILES CONCENTRATIONS (ug/kg)[1]

Location	Depth (ft)	Chemical Constituent						
		Acetone	2-Butanone	Ethylbenzene	Methylene chloride	Toluene	Total Xylenes	Trichloroethene
B2	2-3	14,000[2]	ND[3]	800[2,4]	5,500[2,4]	ND	ND	ND
B3	8-9	46,000	ND	ND	2,600[2,4]	750	ND	ND
	11-12	2,800	ND	990[2,4]	1,700[2,4]	ND	ND	ND
B4	2-3	1,400	ND	940[2,4]	5,700[2,4]	ND	ND	ND
B5	24-27	ND	ND	1,800[4]	3,600[4]	ND	ND	ND
	28-29	ND	ND	1,100[4]	2,000[4]	ND	ND	ND
	30-31	ND	ND	890[4]	2,200[4]	ND	ND	ND
B6	0-1	ND	1,400	1,600[2,4]	2,400[4]	ND	660[4,5]	ND
	1-2	ND	ND	1,000[2,4]	3,000[4]	ND	ND	ND
	2-3	ND	ND	1,000[2,4]	880[4]	ND	ND	ND
	3-4	ND	ND	890[2,4]	1,000[4]	ND	ND	ND
	4-5	52,000	ND	1,000[2,4]	990[4]	ND	ND	ND
	15-16	5,900	ND	850[2,4]	790[4]	ND	ND	ND
	25-26	ND	1,600[4]	970[2,4]	3,200[2,4]	ND	ND	ND
	29-30	ND	1,700[4]	1,100[2,4]	2,200[2,4]	ND	ND	ND
	33-34	1,500[4]	1,600[4]	920[2,4]	2,800[2,4]	ND	680[2,4]	ND
	34-35	ND	ND	1,100[2,4]	2,300[2,4]	ND	ND	ND
	33-36	ND	860[4]	860[2,4]	2,700[2,4]	ND	ND	ND
B7	0-3	ND	ND	840[2,4]	5,900[2,4]	ND	ND	ND
	13-14	ND	ND	780[2,4]	2,100[2,4]	ND	ND	900
	19-20	ND	1,400[4]	910[4]	ND	ND	ND	ND
	24-27	ND	ND	980[4]	1,100[4]	ND	ND	ND
B16	24-25	4,000	ND	940[2,4]	6,400[2,4]	ND	ND	ND

TABLE 5-8
(Continued)

		Chemical Constituent						
Location	Depth (ft)	Acetone	2-Butanone	Ethylbenzene	Methylene chloride	Toluene	Total Xylenes	Trichloroethene
B17	5-6	14,000(2)	ND	750(2,4)	4,100(2,4)	ND	1,100(2,4)	ND
	9-12	2,800(2)	ND	680(2,4)	3,400(2,4)	ND	930(2,4)	ND
	21-24	3,800(2)	ND	990(2,4)	3,600(2,4)	ND	1,400(2,4)	ND
TW-N(5)	0-3	ND	ND	880(2,4)	2,400(2,4)	ND	ND	ND
S3	Surface	ND	ND	3,400(2,4)	12,000(2,4)	ND	4,600(2,4)	ND
S5	Surface	ND	ND	2,700(2,4)	7,800(2,4)	ND	3,600(2,4)	ND

Notes: (1) All volatile organics that were detected at levels above the detection limit are presented. Depths at which samples were analyzed but volatile organics were not detected are not presented. See Table 5-6 for a complete sample analysis schedule.

(2) Present in field blank above limit of detection.

(3) ND = Not detected at or above detection limit.

(4) Present in method blank above limit of detection.

(5) TW-N = Assumed background location for soil.

to indicate that all of these are artifacts. For acetone and 2-butanone, only part of the sample shows contamination. This indicates that there has been some contamination, but that, possibly, not all samples have been affected. Although toluene was present in some blanks, it was not present in the blanks associated with the one borehole sample which showed its presence.

The semi-volatiles detected in sediment and soil include polynuclear aromatic hydrocarbons (PAHs), commonly associated with incomplete combustion reactions; phthalates, which are used as plasticizers and occur frequently in environmental samples (and, therefore, are not a concern in these samples); nitroaromatics; and a furan which is also commonly associated with incomplete combustion.

As indicated in Table 5-7, PAHs were detected with the greatest frequency (6 in a total of 16 borings from which samples were analyzed). The furans and nitroaromatics were detected with the least frequency (2 in a total of 16 borings).

The concentration of semi-volatiles in soil and sediment are summarized in Table 5-9. In general, the incomplete combustion products (i.e., PAHs) were confined to areas adjacent to the pond in soil and the priority pollutant nitroaromatics were confined to the eastern portion of the quarry. This distribution is consistent with activities that took place in these areas; that is, burning of waste in the pond area and disposal of nitroaromatic waste in the eastern portion of the site.

Maximum observed concentrations of the PAHs included 150,000, 190,000, and 110,000 ug/kg for phenathrene, fluoranthene, and benzo(b)fluoranthene, respectively. These maximum concentrations were observed in boring B6. The maximum observed concentrations for the priority pollutant nitroaromatics 2,4-DNT and 2,6-DNT included 10,000 and 3,700 ug/kg, respectively. These maximum concentrations were observed in boring B16.

TABLE 5-9

SUMMARY OF SEMI-VOLATILE CONCENTRATIONS (ug/kg)[1]

Semi-Volatile	Depth (ft)	Location B3	B4	B5	B6	B7	B8	B14	B15	B16	TW-N[2]	S1[3]	S5[3]
Napthalene	0-3	ND[4]	1,300	ND	ND	ND	ND	ND	ND	NA	ND	ND	5,500
	3-6	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	NA	NA
	6-9	ND	ND	NA	ND	ND	ND	NA	NA	NA	NA	NA	NA
	9-12	ND	NA	NA	NA	ND	NA	NA	NA	ND	NA	NA	NA
	12-15	NA[5]	NA	NA	NA	ND	NA	NA	NA	ND	NA	NA	NA
	15-16	NA	NA	NA	ND	NA	NA	NA	NA	NA	NA	NA	NA
	15-18	NA	NA	NA	NA	ND	NA	NA	NA	ND	NA	NA	NA
	18-21	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	NA	NA
	21-24	NA	NA	NA	NA	ND	NA	NA	NA	NA	NA	NA	NA
Acenaphthene	0-3	ND	1,700	ND	ND	ND	ND	ND	ND	NA	ND	ND	3,000
	3-6	ND	ND	NA	ND	ND	NA	ND	NA	ND	NA	NA	NA
	6-9	ND	ND	4,500	ND	18,000	6,000	NA	NA	NA	NA	NA	NA
	9-12	ND	NA	NA	NA	ND	NA	NA	NA	ND	NA	NA	NA
	12-15	NA	NA	NA	NA	ND	NA	NA	NA	ND	NA	NA	NA
	15-16	NA	NA	NA	ND	NA	NA	NA	NA	NA	NA	NA	NA
	15-18	NA	NA	NA	NA	ND	NA	NA	NA	ND	NA	NA	NA
	18-21	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	NA	NA
	21-24	NA	NA	NA	NA	ND	NA	NA	NA	NA	NA	NA	NA
Dibenzofuran	0-3	ND	1,400	ND	ND	ND	ND	ND	ND	NA	ND	ND	1,700
	3-6	ND	ND	NA	ND	ND	NA	ND	NA	ND	NA	NA	NA
	6-9	ND	ND	ND	ND	ND	3,600	NA	NA	NA	NA	NA	NA
	9-12	ND	NA	NA	NA	ND	NA	NA	NA	ND	NA	NA	NA
	12-15	NA	NA	NA	NA	ND	NA	NA	NA	ND	NA	NA	NA
	15-16	NA	NA	NA	ND	NA	NA	NA	NA	NA	NA	NA	NA
	15-18	NA	NA	NA	NA	ND	NA	NA	NA	ND	NA	NA	NA
	18-21	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	NA	NA
	21-24	NA	NA	NA	NA	ND	NA	NA	NA	NA	NA	NA	NA

TABLE 5-9 (Continued)

Semi-Volatile	Depth (ft)	Location B3	B4	B5	B6	B7	B8	B14	B15	B16	TW-N(2)	S1(3)	S5(3)
Phenanthrene	0-3	3,900	14,000	2,400	3,300	1,100	4,600	ND	ND	NA	ND	ND	18,000
	3-6	2,600	1,200	NA	16,000	1,500	NA	ND	NA	ND	NA	NA	NA
	6-9	2,600	740	48,000	2,000	120,000	56,000	NA	NA	NA	NA	NA	NA
	9-12	730	NA	NA	NA	120,000	NA	NA	NA	ND	NA	NA	NA
	12-15	NA	NA	NA	NA	4,200	NA	NA	NA	ND	NA	NA	NA
	15-16	NA	NA	NA	150,000	NA	NA	NA	NA	NA	NA	NA	NA
	15-18	NA	NA	NA	NA	1,300	NA	NA	NA	ND	NA	NA	NA
	18-21	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	NA	NA
	21-24	NA	NA	NA	NA	12,000	NA	NA	NA	NA	NA	NA	NA
Anthracene	0-3	550	2,100	ND	690	ND	ND	ND	ND	NA	ND	ND	3,000
	3-6	390	ND	NA	ND	ND	NA	ND	NA	ND	NA	NA	NA
	6-9	490	ND	9,000	340	33,000	11,000	NA	NA	NA	NA	NA	NA
	9-12	ND	NA	NA	NA	28,000	NA	NA	NA	ND	NA	NA	NA
	12-15	NA	NA	NA	NA	610	NA	NA	NA	ND	NA	NA	NA
	15-16	NA	NA	NA	37,000	NA	NA	NA	NA	NA	NA	NA	NA
	15-18	NA	NA	NA	NA	ND	NA	NA	NA	ND	NA	NA	NA
	18-21	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	NA	NA
	21-24	NA	NA	NA	NA	2,500	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	0-3	3,500	12,000	2,700	3,300	1,400	6,000	ND	ND	NA	ND	900	18,000
	3-6	4,000	1,300	NA	15,000	1,300	NA	ND	NA	ND	NA	NA	NA
	6-9	3,100	780	53,000	2,200	8,600	58,000	NA	NA	NA	NA	NA	NA
	9-12	970	NA	NA	NA	140,000	NA	NA	NA	ND	NA	NA	NA
	12-15	NA	NA	NA	NA	4,600	NA	NA	NA	ND	NA	NA	NA
	15-16	NA	NA	NA	190,000	NA	NA	NA	NA	NA	NA	NA	NA
	15-18	NA	NA	NA	NA	1,100	NA	NA	NA	ND	NA	NA	NA
	18-21	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	NA	NA
	21-24	NA	NA	NA	NA	18,000	NA	NA	NA	NA	NA	NA	NA
Pyrene	0-3	4,900	15,000	3,000	2,500	1,300	5,100	ND	ND	NA	ND	ND	14,000
	3-6	3,500	1,100	NA	8,700	1,300	NA	ND	NA	ND	NA	NA	NA
	6-9	2,600	680	ND	1,900	76,000	57,000	NA	NA	NA	NA	NA	NA

TABLE 5-9 (Continued)

Semi-Volatile	Depth (ft)	Location B3	B4	B5	B6	B7	B8	B14	B15	B16	TW-N(2)	S1(3)	S5(3)
Pyrene (Continued)	9-12	830	NA	NA	NA	110,000	NA	NA	NA	ND	NA	NA	NA
	12-15	NA	NA	NA	NA	4,800	NA	NA	NA	ND	NA	NA	NA
	15-16	NA	NA	NA	170,000	NA	NA	NA	NA	NA	NA	NA	NA
	15-18	NA	NA	NA	NA	870	NA	NA	NA	ND	NA	NA	NA
	18-21	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	NA	NA
	21-24	NA	NA	NA	NA	15,000	NA	NA	NA	NA	NA	NA	NA
Benzo(a)Anthracene	0-3	3,000	6,600	1,600	2,000	650	ND	ND	ND	NA	ND	ND	8,200
	3-6	1,900	660	NA	ND	550	NA	ND	NA	ND	NA	NA	NA
	6-9	ND	ND	17,000	1,200	38,000	32,000	NA	NA	NA	NA	NA	NA
	9-12	550	NA	NA	NA	63,000	NA	NA	NA	ND	NA	NA	NA
	12-15	NA	NA	NA	NA	2,100	NA	NA	NA	ND	NA	NA	NA
	15-16	NA	NA	NA	86,000	NA	NA	NA	NA	NA	NA	NA	NA
	15-18	NA	NA	NA	NA	530	NA	NA	NA	ND	NA	NA	NA
	18-21	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	NA	NA
	21-24	NA	NA	NA	NA	6,600	NA	NA	NA	NA	NA	NA	NA
Chrysene	0-3	2,700	5,200	1,500	1,600	710	ND	ND	ND	NA	ND	ND	7,200
	3-6	1,600	660	NA	ND	640	NA	ND	NA	ND	NA	NA	NA
	6-9	1,800	460	17,000	1,200	34,000	32,000	NA	NA	NA	NA	NA	NA
	9-12	630	NA	NA	NA	60,000	NA	NA	NA	ND	NA	NA	NA
	12-15	NA	NA	NA	NA	2,000	NA	NA	NA	ND	NA	NA	NA
	15-16	NA	NA	NA	89,000	NA	NA	NA	NA	NA	NA	NA	NA
	15-18	NA	NA	NA	NA	520	NA	NA	NA	ND	NA	NA	NA
	18-21	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	NA	NA
	21-24	NA	NA	NA	NA	6,500	NA	NA	NA	NA	NA	NA	NA
Benzo(b)Fluoranthene	0-3	4,200	3,800	1,300	2,500	940	ND	ND	ND	NA	ND	980	13,000
	3-6	2,500	900	NA	9,900	810	NA	ND	NA	ND	NA	NA	NA
	6-9	2,600	620	26,000	1,500	46,000	47,000	NA	NA	NA	NA	NA	NA
	9-12	890	NA	NA	NA	89,000	NA	NA	NA	ND	NA	NA	NA
	12-15	NA	NA	NA	NA	1,500	NA	NA	NA	ND	NA	NA	NA

TABLE 5-9 (Continued)

Semi-Volatile	Depth (ft)	Location B3	B4	B5	B6	B7	B8	B14	B15	B16	TW-N(2)	S1(3)	S5(3)
Benzo(b)Fluoranthene (Continued)	15-16	NA	NA	NA	110,000	NA	NA	NA	NA	NA	NA	NA	NA
	15-18	NA	NA	NA	NA	670	NA	NA	NA	ND	NA	NA	NA
	18-21	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	NA	NA
	21-24	NA	NA	NA	NA	8,800	NA	NA	NA	NA	NA	NA	NA
Benzo(a)Pyrene	0-3	2,300	5,100	1,300	1,500	510	ND	ND	ND	NA	ND	ND	6,200
	3-6	2,900	540	NA	7,000	460	NA	ND	NA	ND	NA	NA	NA
	6-9	2,900	650	15,000	990	31,000	26,000	NA	NA	NA	NA	NA	NA
	9-12	1,000	NA	NA	NA	47,000	NA	NA	NA	ND	NA	NA	NA
	12-15	NA	NA	NA	NA	1,700	NA	NA	NA	ND	NA	NA	NA
	15-16	NA	NA	NA	68,000	NA	NA	NA	NA	NA	NA	NA	NA
	15-18	NA	NA	NA	NA	ND	NA	NA	NA	ND	NA	NA	NA
	18-21	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	NA	NA
	21-24	NA	NA	NA	NA	4,300	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)Pyrene	0-3	2,100	3,000	1,000	1,200	ND	ND	ND	ND	NA	ND	ND	4,800
	3-6	1,500	450	NA	ND	ND	NA	ND	NA	ND	NA	NA	NA
	6-9	1,400	ND	8,400	770	18,000	25,000	NA	NA	NA	NA	NA	NA
	9-12	490	NA	NA	NA	33,000	NA	NA	NA	ND	NA	NA	NA
	12-15	NA	NA	NA	NA	1,600	NA	NA	NA	ND	NA	NA	NA
	15-16	NA	NA	NA	49,000	NA	NA	NA	NA	NA	NA	NA	NA
	15-18	NA	NA	NA	NA	ND	NA	NA	NA	ND	NA	NA	NA
	18-21	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	NA	NA
	21-24	NA	NA	NA	NA	2,400	NA	NA	NA	NA	NA	NA	NA
Dibenz(a,h)Anthracene	0-3	910	1,400	ND	630	ND	ND	ND	ND	NA	ND	ND	ND
	3-6	1,300	ND	NA	ND	ND	NA	ND	NA	ND	NA	NA	NA
	6-9	1,200	ND	ND	330	ND	ND	NA	NA	NA	NA	NA	NA
	9-12	ND	NA	NA	NA	17,000	NA	NA	NA	ND	NA	NA	NA
	12-15	NA	NA	NA	NA	580	NA	NA	NA	ND	NA	NA	NA
	15-16	NA	NA	NA	ND	NA	NA	NA	NA	NA	NA	NA	NA
	15-18	NA	NA	NA	NA	ND	NA	NA	NA	ND	NA	NA	NA
	18-21	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	NA	NA
	21-24	NA	NA	NA	NA	ND	NA	NA	NA	NA	NA	NA	NA

TABLE 5-9 (Continued)

Semi-Volatile	Depth (ft)	Location B3	B4	B5	B6	B7	B8	B14	B15	B16	TW-N(2)	SI(3)	S5(3)
Benzo(g,h,i)Perylene	0-3	1,800	3,800	880	1,600	ND	ND	ND	ND	NA	ND	ND	6,000
	3-6	1,300	410	NA	4,600	ND	NA	ND	NA	ND	NA	NA	NA
	6-9	ND	ND	12,000	840	23,000	22,000	NA	NA	NA	NA	NA	NA
	9-12	430	NA	NA	NA	40,000	NA	NA	NA	ND	NA	NA	NA
	12-15	NA	NA	NA	NA	1,500	NA	NA	NA	ND	NA	NA	NA
	15-16	NA	NA	NA	50,000	NA	NA	NA	NA	NA	NA	NA	NA
	15-18	NA	NA	NA	NA	ND	NA	NA	NA	ND	NA	NA	NA
	18-21	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	NA	NA
	21-24	NA	NA	NA	NA	3,000	NA	NA	NA	NA	NA	NA	NA
2,4-Dinitrotoluene	0-3	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	ND
	3-6	ND	ND	NA	ND	ND	NA	ND	NA	9,700	NA	NA	NA
	6-9	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA
	9-12	ND	NA	NA	NA	ND	NA	NA	NA	7,100	NA	NA	NA
	12-15	NA	NA	NA	NA	ND	NA	NA	NA	10,000	NA	NA	NA
	15-16	NA	NA	NA	ND	NA	NA	NA	NA	NA	NA	NA	NA
	15-18	NA	NA	NA	NA	ND	NA	NA	NA	1,700	NA	NA	NA
	18-21	NA	NA	NA	NA	NA	NA	NA	NA	2,900	NA	NA	NA
	21-24	NA	NA	NA	NA	ND	NA	NA	NA	NA	NA	NA	NA
2,6-Dinitrotoluene	0-3	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	ND
	3-6	ND	ND	NA	ND	ND	NA	ND	NA	ND	NA	NA	NA
	6-9	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA
	9-12	ND	NA	NA	NA	ND	NA	NA	NA	3,700	NA	NA	NA
	12-15	NA	NA	NA	NA	ND	NA	NA	NA	1,500	NA	NA	NA
	15-16	NA	NA	NA	ND	NA	NA	NA	NA	NA	NA	NA	NA
	15-18	NA	NA	NA	NA	ND	NA	NA	NA	720	NA	NA	NA
	18-21	NA	NA	NA	NA	NA	NA	NA	NA	530	NA	NA	NA
	21-24	NA	NA	NA	NA	ND	NA	NA	NA	NA	NA	NA	NA
Bis(2-ethylhexyl)Phthalate	0-3	ND	ND	ND	ND	ND	ND	790	660	NA	1,800	ND	ND
	3-6	1,600	ND	NA	ND	ND	NA	ND	NA	ND	NA	NA	NA
	6-9	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA

TABLE 5-9 (Continued)

Semi-Volatile	Depth (ft)	Location B3	B4	B5	B6	B7	B8	B14	B15	B16	TW-N[(2)]	S1[(3)]	S5[(3)]
Bis(2-ethylhexyl)Phthalate (Continued)	9-12	ND	NA	NA	NA	ND	NA	NA	NA	ND	NA	NA	NA
	12-15	NA	NA	NA	NA	ND	NA	NA	NA	ND	NA	NA	NA
	15-16	NA	NA	NA	ND	NA	NA	NA	NA	NA	NA	NA	NA
	15-18	NA	NA	NA	NA	ND	NA	NA	NA	ND	NA	NA	NA
	18-21	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	NA	NA
	21-24	NA	NA	NA	NA	ND	NA	NA	NA	NA	NA	NA	NA
Benzo(k)Fluoranthene	0-3	ND	ND	780	ND	ND	ND	ND	ND	NA	ND	ND	ND
	3-6	ND	ND	NA	ND	ND	NA	ND	NA	ND	NA	NA	NA
	6-9	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA
	9-12	ND	NA	NA	NA	ND	NA	NA	NA	ND	NA	NA	NA
	12-15	NA	NA	NA	NA	980	NA	NA	NA	ND	NA	NA	NA
	15-16	NA	NA	NA	ND	NA	NA	NA	NA	NA	NA	NA	NA
	15-18	NA	NA	NA	NA	ND	NA	NA	NA	ND	NA	NA	NA
	18-21	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	NA	NA
	21-24	NA	NA	NA	NA	ND	NA	NA	NA	NA	NA	NA	NA
Fluorene	0-3	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	ND
	3-6	ND	ND	NA	ND	ND	NA	ND	NA	ND	NA	NA	NA
	6-9	ND	ND	ND	ND	19,000	ND	NA	NA	NA	NA	NA	NA
	9-12	ND	NA	NA	NA	15,000	NA	NA	NA	ND	NA	NA	NA
	12-15	NA	NA	NA	NA	ND	NA	NA	NA	ND	NA	NA	NA
	15-16	NA	NA	NA	13,000	NA	NA	NA	NA	NA	NA	NA	NA
	15-18	NA	NA	NA	NA	ND	NA	NA	NA	ND	NA	NA	NA
	18-21	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	NA	NA
	21-24	NA	NA	NA	NA	6,600	NA	NA	NA	NA	NA	NA	NA
Di-n-butyl-pthalate	0-3	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	ND
	3-6	ND	ND	NA	ND	ND	NA	470	NA	ND	NA	NA	NA
	6-9	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA
	9-12	ND	NA	NA	NA	ND	NA	NA	NA	ND	NA	NA	NA
	12-15	NA	NA	NA	NA	580	NA	NA	NA	ND	NA	NA	NA

TABLE 5-9 (Continued)

Semi-Volatile	Depth (ft)	Location											
		B3	B4	B5	B6	B7	B8	B14	B15	B16	TW-N(2)	S1(3)	S5(3)
Di-n-butyl-pthalate (Continued)	15-16	NA	NA	NA	ND	NA	NA	NA	NA	NA	NA	NA	NA
	15-18	NA	NA	NA	NA	ND	NA	NA	NA	ND	NA	NA	NA
	18-21	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	NA	NA
	21-24	NA	NA	NA	NA	ND	NA	NA	NA	NA	NA	NA	NA

Notes: (1) All semi-volatile organics that were detected at levels above the detection limit are presented. Depths at which samples were analyzed but volatile organics were not detected are not presented. See Table 5-6 for a complete sample analysis schedule.

(2) TW-N = Assumed background location for soil.

(3) Surface sample.

(4) ND = Not detected at or above detection limit.

(5) NA = Not analyzed at this depth (See Table 5-6 for complete analytical schedule).

The semi-volatile compounds found in pond sediment are consistent with the distribution of these compounds in soil; that is, the presence of PAHs and the absence of nitroaromatics in this portion of the site. The maximum observed concentrations of the PAHs in sediment included 18,000, 18,000, and 13,000 ug/kg for phenathrene, fluoranthene, and benzo(b)fluoranthene. These PAHs are the same compounds in which maximum concentrations were observed in soil.

Semi-volatiles were not found in sediment sampling locations S2, S3, and S4. These compounds appear to be confined to the sediment in the eastern portion of the sump. The PAHs and priority pollutant nitroaromatics were not detected at the assumed background location, boring TW-M.

Nitroaromatics, including non-priority pollutants, were also analyzed using procedures developed by the U.S. Army. These procedures quantify the priority pollutant nitroaromatics (i.e. 2,4-DNT and 2,6-DNT) and a number of non-priority pollutant nitroaromatics including: 2,6-Diamino-4-Nitrotoluene, 2,4,6-Trinitrotoluene, and 2,4-Diamino-6-Nitrotoluene. As indicated in Table 5-7, 2,4,6-TNT was detected in the greatest frequency (6 in a total of 17 borings from which samples were analyzed.)

The concentration of nitroaromatics in soil and sediment are shown in Table 5-10. Of the nitroaromatics, TNT was detected in soil samples with the greatest frequency (27 of 67 samples). TNT also occurred in the highest concentration of the nitroaromatics, with concentrations of 1,478,000 and 1,600,000 ug/kg in borings B16 (9-12 ft depth) and B17 (3-6 ft depth), respectively.

The largest number and the highest concentrations of nitroaromatics were found in the eastern portion of the site (borings B16 and B17), near the terminus of an access road from Missouri State Highway 94. Nitroaromatics were not detected in borings B13, B14, and B15 located 75 to 100 ft east of borings B16 and B17. Nitroaromatics were detected infrequently and in relatively low concentrations in

TABLE 5-10

SUMMARY OF NITROAROMATICS CONCENTRATIONS (ug/kg)[1]

Location	Depth (ft)	2,6-Diamino-4-Nitrotoluene	2,4,6-Trinitrotoluene	2,4-Dinitrotoluene	2,6-Dinitrotoluene	2,4-Diamino-6-Nitrotoluene
B1	0-1	ND[2]	3,160	ND	ND	ND
B5	27-30	540	ND	ND	ND	ND
	30-32	376	ND	ND	ND	
B7	9-12	540	ND	ND	ND	
	24-27	330	ND	ND	ND	ND
	30-30	580	ND	ND	ND	
B8	0-3	ND	1,230	ND	ND	ND
B10	0-1	ND	1,550	903	1,160	ND
B11	0-3	ND	42,200	ND	ND	ND
B16	0-3	ND	688,000	9,610	19,100	3,110
	3-5	332	690,000	22,900	68,000	4,580
	9-12	ND	1,478,000	12,800	12,000	1,280
	12-15	560	27,100	33,100	4,220	ND
	15-18	ND	8,250	15,400	3,650	ND
	18-21	ND	4,900	10,500	2,330	ND
	21-24	ND	2,390	620	ND	ND
	24-25	ND	850	ND	ND	ND
	26-27	ND	850	ND	ND	ND
	27-29	ND	940	ND	ND	ND
B17	0-2	ND	414,000	1,140	362	7,030
	3-6	ND	1,600,000	910	1,240	ND
	6-9	ND	681,000	459	557	5,280
	9-12	ND	370,000	600	465	7,270
	12-15	ND	1,440	ND	ND	ND
	15-18	ND	968	ND	ND	ND
	18-21	ND	375	ND	ND	ND
	21-24	ND	8,220	2,780	404	ND
	24-25	ND	2,380	1,330	ND	ND
S5	Surface	ND	330	ND	ND	ND
TW-N[3]	0-3	ND	ND	ND	ND	ND

Notes: (1) All nitroaromatics that were detected at levels above the detection limit are presented. Depths at which samples were analyzed but nitroaromatics were not detected are not presented. See Table 5-6 for a complete sample analysis schedule.

(2) ND = Not Detected at or above detection limit.

(3) TW-N = Assumed background location for soil.

some borings near the quarry pond. TNT was the only nitroaromatic observed in sediment from the pond with a concentration of 330 ug/kg at location S5. Nitroaromatics were not observed in samples from the assumed background location, boring TW-N.

Two of a total of seven PCB aroclors (aroclor 1254 and 1260) were detected in sediment and soil. As indicated in Table 5-7, aroclor 1254 was detected with the greatest frequency (8 in a total of 16 borings from which samples were analyzed). Only 14 of 65 soil samples indicated the presence of PCBs.

The concentration of PCBs in soil and sediment are summarized in Table 5-11. The maximum PCB concentration was 120,000 ug/kg for aroclor 1254 in boring B8 (0-3 ft depth). With the exception of boring B12, most of the PCBs detected at the site appear to be confined to the southern portion of the study area. Only one sediment sample (S3), located along the eastern portion of the quarry pond, indicated the presence of PCBs. At this location aroclor 1254 was detected at a concentration of 4,800 ug/kg. PCBs were not observed in samples from the assumed background location, boring TW-N.

The vertical distribution of chemicals in soil at the WSQ is controlled by geologic conditions, physical-chemical factors of the individual compounds which control transport and deposition (discussed in greater detail in Subsection 5.3), and previous disposal practices. In order to further evaluate the presence of various chemicals with depth, the total chemical concentrations by analytical group (i.e., PCBs, nitroaromatics, semi-volatiles, and volatiles) was calculated for given depths. These results are summarized in Table 5-12.

Table 5-12 was generated by summing all concentrations of chemicals by class (i.e., volatiles, semi-volatiles, nitroaromatics, PCBs); then, the concentrations over specific intervals were summed by

TABLE 5-11

SUMMARY OF PCBs CONCENTRATIONS (ug/kg)(1)

Location	Depth (ft)	Aroclor 1254	Aroclor 1260
B3	0-3	ND(2)	9,100
	3-6	ND	11,800
	6-9	4,200	ND
	27-30	460	ND
B4	6-9	7,400	ND
B5	0-3	19,000	ND
B6	0-3	18,000	ND
	3-6	34,000	ND
	6-9	6,500	ND
B7	0-3	22,000	ND
B8	0-3	120,000	ND
B9	0-2	5,000	ND
B12	0-3	8,400	ND
B14	0-3	4,400	ND
TW-N(3)	0-3	ND	ND
S3	Surface	4,800	ND

Note: (1) All PCBs that were detected at levels above the detection limit are presented. Depths at which samples were analyzed but PCBs were not detected are not presented. See Table 5-6 for a complete sample analysis schedule.

(2) ND = Not detected at or above detection limit.

(2) TW-N = Assumed background location for soil.

TABLE 5-12

VERTICAL DISTRIBUTION OF CHEMICALS AT THE WELDON SPRING QUARRY

Depth (ft)	Percent of Total Detected Mass (1)			
	PCBs	Volatiles	Semi-Volatiles	Nitroaromatics
0-6	93	38	8	57
0-12	100	61	64	98
0-18	100	64	94	99

(1) Values were calculated by totaling all concentrations for each group of compounds at a particular depth and then dividing by the total concentration at all depths.

class and these numbers were divided by the total. This gave the percentage of a class of chemicals in a particular interval.

As indicated in the table, PCBs were generally limited to near-surface depths (0-6 ft), while the nitroaromatics, volatiles, and semi-volatiles were detected at greater depths. Nitroaromatics were generally confined to depth intervals of 0-12 ft. Most of the semi-volatile mass was found in the 0-18 ft interval. Nearly 36 percent of the mass of detected volatiles was found at depths exceeding 18 ft. The vertical distribution of volatiles may be explained by an apparent mobility in soil relative to the other chemical groups, disposal practices, or laboratory artifact. Laboratory artifact is indicated, since most of the volatiles detected in soil were also found in method blanks. The vertical distributions of chemicals in soil for each borehole are shown on bar charts in Appendix B.

Water used for cooling and lubrication during drilling operations was obtained from a fixed tank at the site. The water in the tank was drawn from a fire hydrant at the WSCP. A water sample collected from the fixed tank was analyzed for semi-volatiles, PCBs, and nitroaromatics. The analysis indicated the water was free of semi-volatiles and PCBs. One nitroaromatic compound (2,6-DNT), however, was detected at a concentration of 15 ug/l.

A decision was made, based on the analytical results, to collect additional samples from the water system at the WSCP. However, during the period between the initial sample collection and the completed analysis, the fire hydrant (the original water source) was no longer in operation. The second set of samples was collected from a hydrant on the same water system from which the first samples were collected and also included a tap water source at the site. Since the water system had already been shut off, the water was collected from the stagnant system, which would tend to make the results conservative.

Nitroaromatics were not detected in any of the water system samples, with method detection limits ranging from 0.03 ug/l to 0.6 ug/l. These results indicate the absence of nitroaromatics from the potable water system at the WSCP. It is possible that the positive value for 2,6-DNT resulting from the first sample from the hydrant system represents a field sampling artifact, since this compound was also detected at low concentrations in a limited number of field blanks.

During Phase 1 of the WSQ characterization, a few samples were analyzed for chemical parameters. Some priority pollutant metals were found in concentrations above background. Cadmium was found in the highest concentration compared to its background concentration. Extraction procedure (EP) toxicity testing indicated results were below regulatory guidelines, suggesting that metals found in the fill are not readily leachable.

Asbestos was below 1 percent in all samples, cyanide was below 1 ppm in each sample. None of the samples exhibited Resource Conservation and Recovery Act (RCRA) corrosivity, reactivity, or ignitability.

The Phase 1 samples were also analyzed for semi-volatiles, PCBs and volatiles. No volatiles were detected in the samples. This supports the claim that a major part of the positive volatile analyses in Phase 2 are laboratory artifacts. The semi-volatiles analysis showed the presence of PAHs in the same general location as those found in Phase 2. The PCB analysis showed the presence of aroclors 1254 and 1260, the same PCBs identified in Phase 2.

The vertical distribution of chemicals is in relative agreement with the distribution of radiological parameters. In many locations, the depth of radiologically contaminated soils exceeding residual contamination guidelines is less than 12 ft. The bulk of the chemicals detected in the study are also found at depths less than 12 ft. Figure 5-1 shows the depths of the subsurface radiological contamination at the WSQ, as determined during Phase 1 surveys.

As a result of Phase 1 work (Ref. 1), a volume of 95,000 yd^3 of radiologically contaminated soil, sediment, and rubble was estimated to be present at the WSQ. As a result of the Phase 2 sampling, the volume of the WSQ fill materials is estimated to be 107,000 yd^3. This estimate was calculated for fill material only and excludes an estimate for contaminated sediments.

Given the nature of chemicals found in soil and sediment at the WSQ, remedial action will be subject to the requirements of both the RCRA and the Atomic Energy Act (AEA). The waste deposited at WSQ is defined under RCRA as hazardous waste since the definition of a hazardous waste in 40 CFR Part 261.3(b)(2) includes "...the case of a mixture of solid waste and one or more listed hazardous wastes, when a hazardous waste listed in subpart D is first added to the solid waste," (Ref. 10) and if such waste is not excluded from regulation under 40 CFR Part 261.3(a)(1). As a result, the wastes in the WSQ are included under this regulation. Subpart D is a list of discarded commercial chemical products, off-specification species, container residues, and spill residues that are hazardous wastes subject to regulation under RCRA. Under subpart D Part 261.33(f), 2,4-DNT and 2,6-DT are listed as hazardous wastes U105 and U106, respectively. The above listed wastes were disposed of at WSQ. Therefore, as a result of 40 CFR Part 261.3(b)(2), since this material was added to, combined, or otherwise mixed with the WSQ wastes, all WSQ wastes are considered hazardous wastes and/or radioactive mixed wastes.

5.3 TRANSPORT AND FATE

The importance of various transport and fate reactions at WSQ may be predicted by the use of various physical-chemical parameters. These parameters include:

- o Solubility - Solubility is defined as the total mass of a substance that will dissolve in a solvent (usually water) at

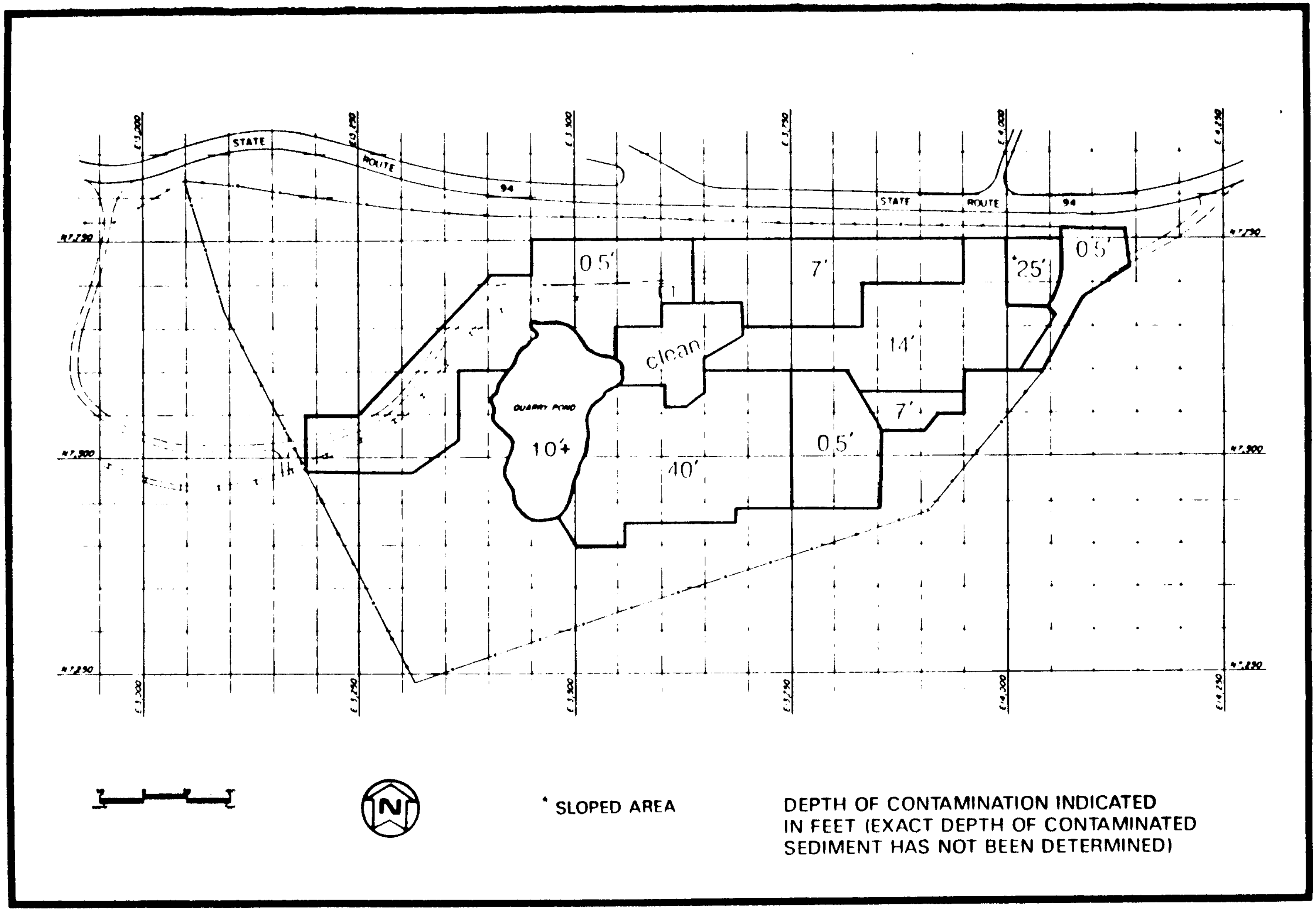


FIGURE 5-1 AREAS OF SUBSURFACE RADIOLOGICAL CONTAMINATION

a given temperature and pressure. The solubility of a substance affects the rate at which molecules of the substance will escape from a liquid via vaporization.

Substances with high vapor pressures and low solubilities will readily vaporize from solution. Conversely, substances with high water solubilities and low vapor pressures will tend to remain in solution or be nonvolatile. Solubility is also, in general, inversely related to sorption on naturally occurring organic material in soil. Therefore, a substance with low solubility is more likely to bind to organic detritus in soil and less likely to move into groundwater.

- Vapor Pressure - Vapor pressure is defined as the pressure exerted by a gas when in equilibrium with its non-gaseous phase. Vapor pressure provides an indication of the escaping tendency of molecules from pure liquids or solids. A high vapor pressure implies low attractive forces between molecules in the liquid or solid and a high number of molecules being emitted into the vapor phase. These substances are considered volatile. Liquids with strong attractive forces, therefore, have low vapor pressures and are considered nonvolatile. Consequently, vapor pressure is an excellent indicator of emissions from pure substances.

- Octanol/Water Partitioning Coefficient - The octanol/water partition coefficient (P_{ow}) is the equilibrium distribution of a solute (i.e., chemical compound) between the two immiscible liquid phases; the constant ratio of the solute's concentration in the upper (octanol) phase to its concentration in the lower (water) phase. This coefficient is useful for the prediction of bioaccumulation and is also related to sorption potential.

Table 5-13 is a list of physical-chemical data for a select number of compounds detected at the WSQ. As indicated in Table 5-13, the

TABLE 5-13

PHYSICAL DATA[1] FOR CHEMICAL COMPOUNDS

FOUND AT THE WELDON SPRING QUARRY

	Vapor[2] Pressure (TORR)	Solubility[3] (ug/l)	Log P_{ow}
Volatiles			
Ethylbenzene	7	152	3.15
Methylene Chloride	362.4	13,200 - 20,000	1.25
Toluene	28.7	534.8	2.69
Trichloroethene	57.9	1,100	2.29
Semi-Volatiles			
Acenaphthene	10^{-3} - 10^{-2}	3.42	4.33
Fluorene	10^{-3} - 10^{-2}	1.98	4.18
Phenanthrene	6.8×10^{-4}	1.00	4.46
Anthracene	1.95×10^{-4}	0.045	4.45
Fluoranthene	10^{-6} - 10^{-4}	0.26	5.33
Pyrene	6.85×10^{-7}	0.14	5.32
Benzo(a)Anthralene	5×10^{-9}	0.014	5.61
Chrysene	10^{-11} - 10^{-6}	0.002	5.61
Benzo(b)Fluoranthene	10^{-11} - 10^{-6}	NA[4]	6.57
Benzo(k)Fluoranthene	9.59×10^{-11}	NA	6.84
Benzo(a)Pyrene	5×10^{-9}	0.0038	6.04
Indeno(1,2,3cd)Pyrene	10^{-10}	NA	7.66
Dibenz(a,h)Anthracene	10^{-10}	0.0005	5.97
Benzo(g,h,i)Perylene	10^{-10}	0.00026	7.23
Naphthalene	0.0492	34.4	3.37
Di-n-Butylphthalate	0.1[5]	13	5.2
Bis(2-Ethyhexyl)Phthalate	0.01	0.4	8.73
Nitroaromatics			
2,4-Dinitrotoluene	0.0013[6]	270	2.01
2,6-Dinitrotoluene	NA	NA	2.05
2,4,6-Trinitrotoluene	0.046[7]	20[8]	NA
PCBs			
Aroclor 1254	7.71×10^{-5}	0.012	6.03
Aroclor 1260	4.05×10^{-5}	0.0027	7.14

(1) Refs. 11,12.
(2) Vapor pressure is at 20°C unless noted.
(3) Solubility is at 25°C unless noted.
(4) NA means not available.
(5) Vapor pressure is at 115°C.
(6) Vapor pressure is at 59°C.
(7) Vapor pressure is at 82°C.
(8) Solubility is at 15°C.

volatiles and nitroaromatics as a group have low to moderate solubilities and low log P_{ow}. This is in contrast to the semi-volatiles and PCBs, which generally have very low aqueous solubilities and elevated log P_{ow}. Because of the low aqueous solubility and vapor pressure (as further indicated by the log P_{ow} values), the semi-volatiles (particularly the PAHs observed at the WSQ) and PCBs are strongly sorbed by particulate matter in groundwater and surface water. As a result, these compounds may be expected to settle in bottom sediments or to be associated with organic detritus in soils. The PCBs and the types of semi-volatiles observed at the WSQ, therefore, are not expected to migrate in appreciable concentrations in surface water or groundwater.

High vapor pressures, low to moderate solubilities, and low log P_{ow} favor the volatiles' partition, primarily into air with low residence time in water. Sorption, unless in the presence of very high organic detritus concentrations, is probably not an important reaction for these compounds (Ref. 11). Migration in groundwater and surface water, therefore, may be an important transport mechanism if these compounds were found at the site. However, analytical results have not conclusively defined their presence at the WSQ. Little physical-chemical, environmental transport, and deposition information is available for the nitroaromatics. Information for the priority pollutant nitroaromatics, which are summarized in Table 5-13, indicates low to moderate solubility, low vapor pressure, and low log P_{ow}. Collectively, this information suggests minimal tendency for adsorption with organic material and volatilization.

The solubilities for these compounds, assuming priority pollutants shown in Table 5-13 are indicative of non-priority pollutants at the WSQ, suggest that movement in groundwater and surface water may be an important transport mechanism.

6.0 SUMMARY AND RECOMMENDATIONS

The Phase 2 characterization at the WSQ involved the collection of soil and sediment samples. Samples were analyzed for chemical constituents including volatile and semi-volatile organics, PCBs, and nitroaromatics. A total of 5 sediment samples and 88 soil samples were analyzed for various combinations of these parameters.

Where applicable, samples were analyzed according to U.S. EPA CLP protocol. Quality control data were evaluated to assess the data accuracy, precision, and the inadvertent introduction of contaminants into samples. The results generally indicated acceptable analytical precision and accuracy. An exception, however, was the analyses of PCBs, which indicated low spike recovery values. These results may indicate a significant matrix effect in the analysis and quantitation of PCBs. The results for field and method blanks indicated minimal inadvertent contaminant introduction in samples, with the exception of volatiles and, to a much lesser extent, the nitroaromatics. The appreciable concentration of volatiles in blanks warrants careful use of these data.

Seven volatile compounds, twenty semi-volatiles, five nitroaromatics, and two PCBs were found at levels above the detection limit in samples from the site. Included in the volatiles were halogenated alkenes, ketones, and aromatics. The semi-volatiles consisted primarily of polynuclear aromatic hydrocarbons and a furan, possibly indicative of incomplete combustion processes, and phthalates, which are plasticizers commonly found in environmental samples.

The distribution of some chemical constituents at the WSQ is consistent with activities known to have taken place at the site including the burning of waste in the quarry area and the disposal of nitroaromatic waste in the eastern portion of the site. Most of the PCBs appear to be confined to the southern portion of the study area. PCBs were generally limited to near-surface depths (0-6 ft) while nitroaromatics, volatiles, and semi-volatiles were detected at greater depths. The bulk of chemical mass is found at depths of less than 12 ft.

The areal distribution of the chemicals can be seen in Figure 6-1. The vertical distribution of chemicals within each borehole is shown on the bar charts in Appendix B. Volatiles were found at all locations sampled. The combustion products were found clustered adjacent to the pond. The greatest concentrations of nitroaromatics were found in the eastern end of the quarry, but showed no pattern for the overall distribution of positive locations. The PCBs, phthalates, and napthalene did not show an areal distribution pattern.

A review of physical-chemical characteristics of selected chemicals found at the WSQ indicated that sorption to soil may be an important process limiting the aqueous transport of PCBs and semi-volatiles. This process probably plays a less important role for volatiles and nitroaromatics and indicates a greater potential for their transport in surface water and groundwater.

Based upon these observations, the following recommendations are provided:

- Sample and analyze groundwater to determine the potential for chemical migration from the site.
- Determine the depth of sediment and vertical distribution of chemical constituents in the quarry sump.
- Collect and analyze additional soil samples from the eastern portion of the site to provide a better understanding of the distribution and volume of soil with elevated concentrations of nitroaromatics.

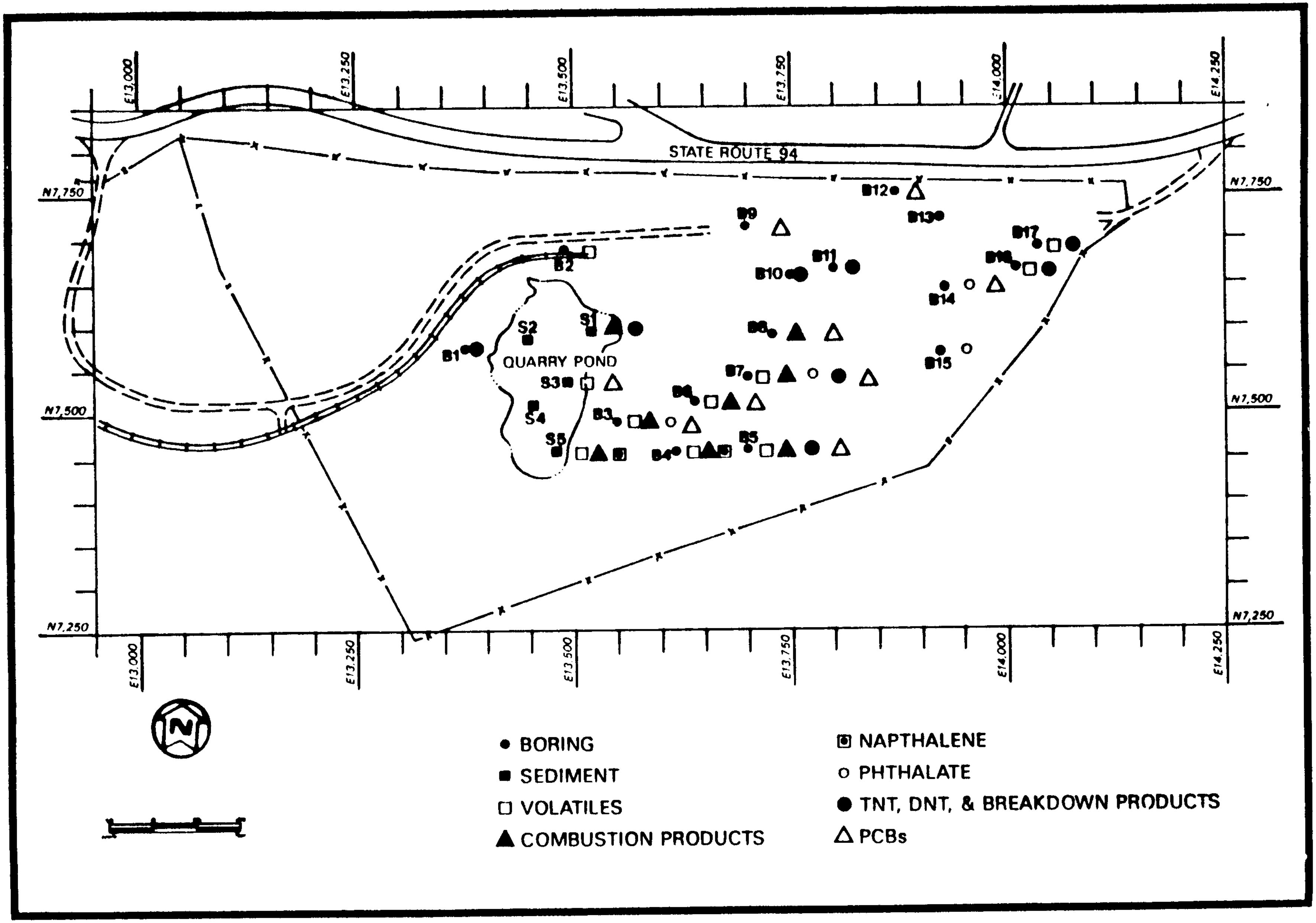


FIGURE 6-1 CHEMICAL CONSTITUENTS AT WSQ BOREHOLES AND SEDIMENT SAMPLING LOCATIONS

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11. United States Environmental Protection Agency. Water-Related Environmental Fate of 129 Priority Pollutants, Volumes I and II, EPA-440/4-79-029a and 029b, December 1979.

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APPENDIX A

GEOLOGIC DRILL LOGS

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP WELDON SPRING	14501	1 OF 1	B01-C

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
QUARRY	N 7575 E 13375	90	0

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH (FT.)
11/29/88	11/29/88	BOB HENSON	SIMCO TR-2	HX	0.4	1.6	2.0

CORE RECOVERY(FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
1.6/100	1		N.A.	476.60	--	0.4/476.20

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 LBS./30 IN.	NONE	L.R. WEST

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLE RECOVERY CORE RECOVERY	SAMPLE BLOWS OR PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							476.60				0.0 - 0.4 FT. <u>SILTY CLAY</u> BROWN WITH BROKEN LIMESTONE.	BACKFILLED WITH 1/4-FT.³ CEMENT SAMPLE 0.0 - 0.4 FT. COLLECTED WITH SHOVEL.
HX CORE	1.6	1.6	100								0.4 - 2.0 FT. <u>LIMESTONE</u> LIGHT GRAY, FINE GRAINED, WEATHERED, HORIZONTAL FRACTURES.	
											BOTTOM OF HOLE: 2.0 FEET.	
							471.60	5				

	SITE	HOLE NO.
SS-SPLIT SPOON; ST-SHELBY TUBE; C-CALIFORNIA	QUARRY	B01-C

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP WELDON SPRING	14501	1 OF 1	010-C

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
QUARRY	N 7685 E 13495	90	0

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH (FT.)
11/11/86	11/11/86	BOB HENSON	MOBILE B-80	HX	4.0	2.0	6.0

CORE RECOVERY(FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
4.5/75	1		N.A.	484.03	--	4.0/480.03

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 LBS./30 IN.	NONE	L.R. WEST

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLE RECOVERY CORE RECOVERY	SAMPLE BLOWS / PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							484.03				0.0 - 1.0 FT. RAILROAD BALLAST, LIMESTONE	BACKFILLED WITH 1/2-FT.^{3} CEMENT.
HX CORE	2.0	1.0	50				483.03	1.0			1.0 - 4.0 FT. SILTY CLAY BROWN, LIMESTONE GRAVEL.	
	2.0	1.5	75									
							479.03	4.0			4.0 - 6.0 FT. LIMESTONE BROWNISH GRAY, MEDIUM GRAINED, HIGHLY WEATHERED, HIGHLY FRACTURED, FOSSILIFEROUS.	
	2.0	2.0	100				479.03	5				
								10			BOTTOM OF HOLE: 6.0 FEET.	

S=SPLIT SPOON; ST=SHELBY TUBE; C=CALIFORNIA	SITE	HOLE NO.
	QUARRY	010-C

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP WELDON SPRING	14500	1 OF 2	002-CA

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
QUARRY	N 7490 E 13660	90	0

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH (FT.)
10/22/86	10/27/86	BOB HENSON	MOBILE B-80	HX	35.0	1.0	36.0

CORE RECOVERY(FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
4.92/20	1		N.A.	480.31	10.5 /469.81	35/445.31

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 LBS./30 IN.	NONE	L.R. WEST

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS / PERCENT CORE RECOVERY
SS 2"	1.5	.8	2-0-12 20
SS 2"	1.5	.75	9-8-4 12
SS 2"	1.5	.7	5-3-3 6
SS 2"	1.5	.8	3-10-11 21
SS 2"	1.5	.75	4-4-9 13
SS 2"	1.5	.8	2-4-5 9
SS 2"	1.5	.5	10-8-14 22
SS 2"	.5	.65	10-12-10 22
HX CORE	1.0	.3	15
HX CORE	2.0	.1	05
SS 2"	1.5	.05	14-16-26 42
SS 2"	1.0	.03	10-21
SS 2"	1.5	.23	10-9-10 19
HX CORE	1.0	.5	50
HX CORE	2.0	.02	01
HX CORE	2.0	0	0
SS 2"	1.0	.3	9-50
HX CORE	1.0	.8	80
HX CORE	.5	.3	60
HX CORE	2.0	.8	40
HX CORE	.5	.3	60
HX CORE	1.5	0	0
HX CORE	2.0	0	0
SS 2"	1.5	.9	9-45-33 78

WATER PRESSURE TESTS: LOSS IN G.P.M. / PRESSURE P.S.I. / TIME IN MINUTES

ELEVATION	DEPTH	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
480.31	0	0.0 - 35.0 FT. FILL TOPSOIL, BLACK AND BROWN, RED BRICK AT 1.0 FT.	BACKFILLED WITH 7 FT.³ CEMENT TO 24.2 FT. FROM 24.2 FT. TO LAND SURFACE WITH LIMESTONE GRAVEL.
		VOID 4.5 - 4.75 FT. SILTY CLAY.	
475.31	5	CONCRETE AND RED BRICK	
470.31	10	TILE, CONCRETE, SILTY SAND 10.5 - 12.0 FT.	▽
		CONCRETE AT 12.0 FT.	
465.31	15	ALUMINUM, WEATHERED LIMESTONE	
		BRICK AT 19.5 FT.	
460.31	20		
		STEEL.	VERY HARD DRILLING AT 27.5 FT. USED 3 BITS IN 4 HRS. NO PROGRESS. MOVED 3 FT. STARTED NEW HOLE (002-CA).
455.31	25	FOAM RUBBER, WOOD, BRICK 26.0 - 27.0 FT.	
		VOID 28.5 - 29.5 FT.	
		GREEN CLAY AT 30.0 FT.	
450.31	30		
		33.5 - 35.0 FT. HIGHLY FRACTURED LIMESTONE, BRICK AND CONCRETE.	

S=SPLIT SPOON; ST=SHELBY TUBE; C=CALIFORNIA

SITE: QUARRY | HOLE NO. 002-CA

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP WELDON SPRING	14501	2 OF 2	B02-CA

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLE RECOVERY CORE RECOVERY	SAMPLE BLOWS % PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	WATER PRESSURE TESTS: PRESSURE P.S.I.	WATER PRESSURE TESTS: TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
HX CORE	1.0	1.0	100								35.8 - 36.8 FT. LIMESTONE LIGHT GRAY (N5), FINE GRAINED, HIGHLY FRACTURED, CRYSTALLINE.	
											BOTTOM OF HOLE: 36.8 FEET.	
							448.31	40				

SS=SPLIT SPOON; ST=SHELBY TUBE; C=CALIFORNIA

SITE: QUARRY

HOLE NO. B02-CA

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP WELDON SPRING	14501	1 OF 2	011-CA

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
QUARRY	N 7465 E 13610	90	0

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH (FT.)
10/27/86	10/29/86	BOB HENSON	MOBILE B-80	HX	37.25	2.25	39.5

CORE RECOVERY(FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
10.2/31	1		N.A.	481.48	10.0/471.48	37.25/444.23

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 LBS./30 IN.	NONE	L.R. WEST

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS / PERCENT CORE RECOVERY
SS 2"	1.5	.85	1-6-8 14
SS 2"	1.5	.92	4-10-16 26
SS 2"	1.5	.5	6-5-9 14
SS 2"	1.5	.5	15-20-24 44
SS 2"	1.5	.45	17-27-11 38
HX CORE	1.0	.8	80
HX CORE	2.0	1.2	60
HX CORE	2.0	.3	15
HX CORE	2.0	.5	25
HX CORE	2.0	.75	38
HX CORE	2.0	1.0	50
HX CORE	1.7	.4	24
HX CORE	1.8	.75	42
HX CORE	1.0	.3	30
NX CORE	2.0	1.0	50
NX CORE	2.0	0	0
NX CORE	7.6	0	0

WATER PRESSURE TESTS: LOSS IN G.P.M. / PRESSURE P.S.I. / TIME IN MINUTES — (none recorded)

ELEVATION	DEPTH
481.48	0
476.48	5
471.48	10
466.48	15
461.48	20
456.48	25
451.48	30

GRAPHIC LOG / SAMPLE

DESCRIPTION AND CLASSIFICATION

0.0 - 37.25 FT. FILL
SILTY SAND, CLAY, BRICK, CONCRETE.

7.5 - 10.5 FT. REBAR, BRICK, TIN, CONCRETE.

11.5 - 12.5 VOID.

13.0 - 14.3 FT. VOID.
GLASS AT 14.5 FT.

14.5 - 16.5 FT. WIRE, BRICK, CONCRETE.

22.0 - 23.0 FT. INSULATED WIRE, REBAR, CONCRETE, GRAVEL.

27.5 - 34.6 FT. VOID (TANK?)

NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.

BACKFILLED TO 21.0 FT. WITH 7.5 FT. CEMENT. 21.0 FT. TO GROUND SURFACE WITH LIMESTONE GRAVEL.

▽ (water level at 10.0 ft.)

SS=SPLIT SPOON; ST=SHELBY TUBE; C=CALIFORNIA

SITE	HOLE NO.
QUARRY	011-CA

BECHTEL

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP WELDON SPRING	14501	2 OF 2	801-CA

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS OR PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
NX CORE	1.3	.3	23								34.6 - 36.9 FT. STEEL, LIMESTONE GRAVEL.	
	2.1	1.4	67				444.23	37.25			37.25 - 39.5 FT. LIMESTONE LIGHT GRAY, FINE GRAINED, INTERBEDDED SHALE, BLUE GRAY, CRYSTALLINE, FOSSILIFEROUS.	
	1.5	1.5	100									
							441.48	40			BOTTOM OF HOLE: 39.5 FEET.	

SS=SPLIT SPOON; ST=SHELBY TUBE; C=CALIFORNIA

SITE: QUARRY

HOLE NO. 801-CA

LOCATION B-5

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP WELDON SPRING	14501	1 OF 1	B03-C

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
QUARRY	N 7465 E 13780	90	0

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH (FT.)
10/30/86	10/31/86	BOB HENSON	MOBILE B-80	HX	31.5	2.5	34

CORE RECOVERY(FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
6.35/28	1		N.A.	482.58	12/469.58	31.5/451.08

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 LBS./30 IN.	NONE	L.R. WEST

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS 6" / PERCENT CORE RECOVERY
SS 2"	1.5	1	1-9-10 19
SS	.5	.3	12
HX CORE	2.0	.8	40
HX CORE	2.0	.5	25
HX CORE	2.0	1	50
HX CORE	2.0	.6	30
HX CORE	2.0	.6	30
HX CORE	1.0	.3	30
HX CORE	2.0	.2	10
HX CORE	6.0	.5	08
HX CORE	2.0	.3	15
SS 2"	1.5	1.5	3-3-5 8
SS 2"	1.5	1.45	3-5-5 10
SS 2"	1.5	1.5	4-5-6 11
SS 2"	1.5	1.2	5-6-7 12
SS 2"	1.5	1.25	7-4-7 11
SS 2"	1.5	.85	5-12-13 25
HX CORE	1.2	1	83
HX CORE	.8	.55	69

WATER PRESSURE TESTS: LOSS IN G.P.M. | PRESSURE P.S.I. | TIME IN MINUTES

ELEVATION	DEPTH
482.58	0
477.58	5
472.58	10
467.58	15
462.58	20
457.58	25
452.58	30
451.08	31.5

GRAPHIC LOG | SAMPLE

DESCRIPTION AND CLASSIFICATION

0.0 - 31.5 FT. FILL
TOPSOIL, SILTY CLAY, BRICK, CONCRETE.

3.0 - 4.0 FT. VOID.

WIRE, STEEL.

11.5 - 12.0 FT. VOID.

16.0 - 21.0 FT. VOID.

23.0 - 31.5 FT. SILTY CLAY, BROWN.

31.5 - 34.0 FT. LIMESTONE
BLUE GRAY, FINE GRAINED, CRYSTALLINE, HIGHLY FRACTURED.

BOTTOM OF HOLE: 34.0 FEET.

NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.

BACKFILLED TO 0.0 FT. WITH 10 FT. CEMENT. 6.0 FT. TO GROUND SURFACE WITH LIMESTONE GRAVEL.

▽ (water level at 12 ft.)

SS=SPLIT SPOON; ST=SHELBY TUBE; C=CALIFORNIA

SITE: QUARRY

HOLE NO. B03-C

LOCATION B-6

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP WELDON SPRING	14501	1 OF 2	B12-C

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
QUARRY	N7515 E 13840	90	0

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH (FT.)
10/29/86	10/30/86	BOB HENSON	MOBILE B-80	HX	35.6	1.9	37.5

CORE RECOVERY(FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
0.58/46	1		N.A.	482.14	11.5/470.64	35.6/446.54

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 LBS./30 IN.	NONE	L.R. WEST

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS / PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH
							482.14	
SS 2"	1.5	1.1	2-7-12 19					
SS 2"	1.5	1.0	6-6-5 11					
SS 2"	1.5	.7	6-8-3 11					
SS 2"	1.0	.6	5-8				477.14	5
HX CORE	2.0	1.0	50					
SS 2"	1.5	.5	11-25-23 48					
SS 2"	1.5	.1	5-12-12 24				472.14	10
HX CORE	2.5	.4	16					
SS 2"	1.5	.25	10-5-6 11					
SS 2"	1.5	.5	8-4-5 9				467.14	15
SS 2"	1.5	0	5-1-1 2					
SS 2"	1.5	.1	5-5-3 8					
HX CORE	2.0	.5	25				462.14	20
HX CORE	2.2	.8	36					
HX CORE	.7	.4	57					
HX CORE	2.1	1.2	57				457.14	25
HX CORE	2.0	.75	38					
HX CORE	2.0	1.5	75				452.14	30
HX CORE	2.0	0	0					
HX CORE	1.2	.45	38					
SS 2"	1.5	1.5	3-4-5 9					

DESCRIPTION AND CLASSIFICATION

0.0 - 35.6 FT. FILL

TOPSOIL, SILTY CLAY.

LIMESTONE FRAGMENTS, BRICK AND CONCRETE GRAVEL.

WOOD, GLASS, REBAR, BRICK

CONCRETE

21.0 - 23.2 FT. VOID.

23.2 - 23.9 FT. CARDBOARD, WOOD.

25.0 - 25.5 FT. VOID.

29.0 - 29.5 FT. CLAY, DARK GRAY.
29.5 - 30.0 FT. VOID.

31.0 FT. CLAY, DARK BROWN.

NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.

BACKFILLED TO 12.0 FT. WITH 9.5 FT.³ CEMENT. 12.0 FT. TO GROUND SURFACE WITH LIMESTONE GRAVEL.

SS=SPLIT SPOON; ST=SHELBY TUBE; C=CALIFORNIA

SITE	HOLE NO.
QUARRY	B12-C

LOCATION B-6 (Continued)

BECHTEL

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP WELDON SPRING	14501	2 OF 2	B12-C

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	WATER PRESSURE TESTS: PRESSURE P.S.I.	WATER PRESSURE TESTS: TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
SS	.9	.9	3-18				446.54	35.6			35.6 - 37.5 FT. LIMESTONE LIGHT GRAY, FINE GRAINED, HIGHLY FRACTURED, CRYSTALLINE.	
HX CORE	1.0	.75	75									
	.9	.8	89									
											BOTTOM OF HOLE: 37.5 FEET.	
							442.14	40				

SS=SPLIT SPOON; ST=SHELBY TUBE; C=CALIFORNIA

SITE QUARRY

HOLE NO. B12-C

BECHTEL

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP WELDON SPRING	14501	1 OF 2	004-C

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
QUARRY	N 7540 E 13700	90	0

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH (FT.)
11/3/86	11/4/86	BOB HENSON	MOBILE B-80	HX	38.0	2.5	40.5

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
11.1/65	1		N.A.	481.54	12/469.54	38/443.54

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 LBS./30 IN.	NONE	L.R. WEST

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS OR PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE
							481.54			
SS 2"	1.5	.5								
SS 2"	1.5	1.2	32-9-10 19							
SS 2"	.9	.3	11-19							
	.6	.2	33							
HX CORE	2.0	1.2	60				476.54	5		
	1.0	.2	20							
SS 2"	1.5	.5	7-13-8 21							
SS 2"	1.3	.95	7-7				471.54	10		
HX CORE	2.2	1.0	45							
	2.0	1.5	75							
SS 2"	1.5	1.2	3-2-19 21				466.54	15		
SS 2"	1.5	.85	15-11-14 25							
SS 2"	1.5	.85	9-5-11 16							
SS 2"	1.0	1.0	5-35							
HX CORE	1.5	1.35	90				461.54	20		
	4.8	3.75	78				456.54	25		
	1.7	.3	18							
SS 2"	1.5	1.5	3-3-5 8							
SS 2"	1.5	1.5	4-6-6 12				451.54	30		
SS 2"	1.5	1.4	3-4-6 10							
SS 2"	1.5	1.4	3-6-6 12							
SS 2"	1.5	1.5	5-6-8 14							

DESCRIPTION AND CLASSIFICATION

0.0 - 38.0 FT. FILL
SILTY CLAY.
0.5 - 2.0 FT. BRICK AND CONCRETE.

3.9 FT. STEEL PLATE, CONCRETE.

5.0 FT. WOOD.

12.6 - 13.1 FT. VOID.

13.5 - 14.25 FT. CLAYEY SILT, BLACK WITH BRICK AND LIMESTONE FRAGMENTS.

14.5 - 17.5 FT. BLACK SILTY CLAY WITH BRICKS AND CONCRETE.

20.5 - 21.5 FT. CLAY, BLACK, PLASTIC.

22.0 - 23.0 FT. VOID.

23.0 - 38.0 FT. SILTY CLAY, BROWN, FIRM.

NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.

BACKFILLED TO GROUND SURFACE WITH 10.5 FT.³ CEMENT.

SS=SPLIT SPOON; ST=SHELBY TUBE; C=CALIFORNIA

SITE	HOLE NO.
QUARRY	004-C

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP WELDON SPRING	14501	2 OF 2	004-C

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS or PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
SS 2"	1.5	1.5	6-8-9 17									
SS 2"	1.5	1.25	6-29-35 64				443.54	38			38.0 - 40.5 FT. LIMESTONE BLUE GRAY, FINE GRAINED, HIGHLY FRACTURED, FOSSILIFEROUS.	
HX CORE	.7	.5	71									
HX CORE	1.3	1.3	100				441.54	40			39.8 - 40.0 FT. SHALE, BLUE GRAY, SOFT.	
											BOTTOM OF HOLE: 40.5 FEET.	

SS=SPLIT SPOON; ST=SHELBY TUBE; C=CALIFORNIA

SITE	HOLE NO.
QUARRY	004-C

BECHTEL

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP WELDON SPRING	14501	1 OF 1	005-C

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
QUARRY	N 7590 E 13730	90	0

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH (FT.)
11/4/86	11/6/86	BOB HENSON	MOBILE B-80	HX	27.3	3.7	31

CORE RECOVERY(FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
5.75/42	1		N.A.	480.76	12.5/468.26	27.3/453.46

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 LBS./30 IN.	NONE	L.R. WEST

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS / PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH
							480.76	0
SS 2"	1.5	1.0	1-7-9 16					
SS 2"	1.3	1.3	20-20-50 70+					
HX CORE	2.2	.75	34					
SS 2"	1.5	.25	8-6-4 10				475.76	5
SS 2"	1.5	.3	3-2-5 7					
SS 2"	1.5	.1	4-4-6 10					
SS 2"	1.5	.3	7-26-6 32				470.76	10
HX CORE	2.0	.8	40					
	.7	.7	100					
SS 2"	1.5	.5	10-8-3 11				465.76	15
SS 2"	.8	.1	2-30+					
SS 2"	1.7	.1	40-2-4 6					
SS 2"	1.5	0	3-5-5 10					
SS 2"	1.5	.7	6-15-11 26				460.76	20
SS 2"	1.5	.3	5-8-6 14					
HX CORE	2.0	.8	40					
	2.0	.3	15				455.76	25
	2.7	1.0	37				453.46	27.3
	1.0	1.2	67				450.76	30

DESCRIPTION AND CLASSIFICATION

0.0 - 27.3 FT. FILL
SILTY CLAY, CONCRETE, BRICK.

WOOD AT 2.0 FT.

WOOD AT 8.0 FT.

8.0 - 11.0 FT. CONCRETE AND BRICK FRAGMENTS.

11.0 - 13.0 FT. WOOD, RUBBER, CONCRETE, BRICK.

13.0 - 13.7 FT. WOOD, BRICK.

13.7 - 16.0 FT. WOOD.

17.0 - 18.0 FT. VOID.

19.0 - 22.0 FT. ASBESTOS, CEMENT, BRICK.

21.0 - 22.5 FT. VOID.

23.0 - 24.5 FT. STEEL DRUM WITH WHITISH SUBSTANCE.

27.3 - 31.0 FT. LIMESTONE
LIGHT GRAY, FINE GRAINED, CRYSTALLINE.
VOID 28.3 - 29.2 FT.

BOTTOM OF HOLE: 31.0 FEET.

NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.

BACKFILLED TO 6.0 FT. WITH 7.5 FT.³ CEMENT. 6.0 FT. TO GROUND SURFACE WITH LIMESTONE GRAVEL.

	SITE	HOLE NO.
SS=SPLIT SPOON; ST=SHELBY TUBE; C=CALIFORNIA	QUARRY	005-C

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP WELDON SPRING	14501	1 OF 1	B13-C

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
QUARRY	N 7710 E 13700	90	0

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH (FT.)
11/7/86	11/7/86	BOB HENSON	MOBILE B-80	HX	1.5	2.0	3.5

CORE RECOVERY(FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
1.7/85	1		N.A.	483.07	--	1.5/481.57

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 LBS./30 IN.	NONE	L.R. WEST

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLE RECOVERY CORE RECOVERY	SAMPLE BLOWS % PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							483.07					
SS 2"	1.5	1.0	6-11-30 41								0.0 - 1.5 FT. SILTY CLAY BROWN, LIMESTONE FRAGMENTS, CONCRETE.	BACKFILLED WITH 3/4-FT. CEMENT.
							481.57	1.5			1.5 - 3.5 FT. LIMESTONE MEDIUM GRAY, FINE GRAINED, FOSSILIFEROUS, HORIZONTAL FRACTURES.	
HX CORE	2.0	1.7	85									
											BOTTOM OF HOLE: 3.5 FEET.	
							478.07	5				

SS=SPLIT SPOON; ST=SHELBY TUBE; C=CALIFORNIA

SITE	HOLE NO.
QUARRY	B13-C

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP WELDON SPRING	14501	1 OF 1	014-C

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
QUARRY	N 7855 E 13750	90	0

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH (FT.)
11/6/86	11/6/86	BOB HENSON	MOBILE B-80	HX	0.2	2.8	3.0

CORE RECOVERY(FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
2.85/95	1		N.A.	480.38	--	0.2/480.18

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 LBS./30 IN.	NONE	L.R. WEST

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS / % / PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							480.38					
HX CORE	2.0	1.85	93				480.18	2			0.0 - 0.2 FT. SILTY CLAY DARK BROWN.	BACKFILLED WITH 0.4 FT.³ CEMENT.
	1.0	1.0	100								0.2 - 3.0 FT. LIMESTONE LIGHT GRAY, FINE GRAINED, CRYSTALLINE. VERTICAL FRACTURES 0.2 - 0.8 FT., 1.0 - 1.5 FT.	
											BOTTOM OF HOLE: 3.0 FEET.	
							475.38	5				

SS=SPLIT SPOON; ST=SHELBY TUBE; C=CALIFORNIA	SITE	HOLE NO.
	QUARRY	014-C

BECHTEL

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP WELDON SPRING	14501	1 OF 1	006-C

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
QUARRY	N 7660 E 13000	90	0

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH (FT.)
11/7/86	11/7/86	BOB HENSON	MOBILE B-80	HX	4.1	1.9	6.0

CORE RECOVERY(FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
3.3/66	1		N.A.	481.57	--	4.1/477.47

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 LBS./30 IN.	NONE	L.R. WEST

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH OF CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS 'N' / PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION 481.57	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
SS 2"	1.0	.9	1-50								0.0 - 4.1 FT. <u>SILTY CLAY</u> BROWN, WITH LIMESTONE FRAGMENTS. 1.0 - 3.0 FT. HIGHLY WEATHERED LIMESTONE FRAGMENTS WITH BROWN SILTY CLAY.	BACKFILLED WITH 1 FT.³ CEMENT.
HX CORE	2.0	1.0	50									
	2.0	1.3	65				477.47	4.1			4.1 - 6.0 FT. <u>LIMESTONE</u> LIGHT GRAY, FINE GRAINED, FOSSILIFEROUS, HIGHLY WEATHERED, HORIZONTAL FRACTURES.	
	1.0	1.0	100				476.57	5				
								10			BOTTOM OF HOLE: 6.0 FEET.	

SS=SPLIT SPOON; ST=SHELBY TUBE; C=CALIFORNIA	SITE	HOLE NO.
	QUARRY	006-C

GEOLOGIC DRILL LOG

PROJECT	FUSRAP WELDON SPRING
JOB NO.	14501
SHEET NO.	1 OF 1
HOLE NO.	B15-C
SITE	QUARRY
COORDINATES	N 7750 E 13075
ANGLE FROM HORIZ.	90
BEARING	0
BEGUN	10/16/86
COMPLETED	10/16/86
DRILLER	BOB HENSON
DRILL MAKE AND MODEL	SIMCO TR-2
HOLE SIZE	HX
OVERBURDEN (FT.)	4.5
ROCK (FT.)	2.0
TOTAL DEPTH (FT.)	6.5
CORE RECOVERY(FT./%)	1.9/95
CORE BOXES	1
SAMPLES	
EL. TOP OF CASING	N.A.
GROUND EL.	505.04
DEPTH/EL. GROUND WATER	3.0/502.04
DEPTH/EL. TOP OF ROCK	4.5/500.54
SAMPLE HAMMER WEIGHT/FALL	140 LBS./30 IN.
CASING LEFT IN HOLE: DIA./LENGTH	NONE
LOGGED BY	L.R. WEST

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLE RECOVERY CORE RECOVERY	SAMPLE BLOWS "N" PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION 505.04	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
SS 2"	1.5	.5	3-6-4 10								0.0 - 4.5 FT. <u>FILL</u> CLAY, SILT WITH LIMESTONE GRAVEL.	
SS 2"	1.5	.5	3-4-4 8									▽
SS 2"	1.5	.7	1-2-3 5									
HX CORE	2.0	1.9	95				500.54 500.04	4.5 5			4.5 - 6.5 FT. <u>LIMESTONE</u> LIGHT GRAY (N5), FINE GRAINED.	L.P. .05 RQD 60
											BOTTOM OF HOLE: 6.5 FEET.	BACKFILLED TO 3 FT. WITH 3 FT.³ CEMENT. 3 FT. TO GROUND SURFACE WITH LIMESTONE GRAVEL.
							495.04	10				

SS=SPLIT SPOON; ST=SHELBY TUBE; C=CALIFORNIA

SITE: QUARRY — HOLE NO. B15-C

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP WELDON SPRING	14501	1 OF 1	007-C

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
QUARRY	N 7720 E 13926	90	0

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH (FT.)
10/15/86	10/16/86	BOB HENSON	MOBILE B-80	HX	7.9	2.3	10.2

CORE RECOVERY(FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
3.4/47	1		N/A	508.28	--	7.9/500.38

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 LBS./30 IN.	NONE	L.R. WEST

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS / % PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION (508.28)	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
HX CORE	2.0	.0	40								0.0 - 7.9 FT. FILL LIMESTONE GRAVEL, RED CLAY, BRICK 1.5 - 2.0 FT.	BACKFILLED TO 5 FT. WITH 7.5 FT.³ CEMENT. 5.0 FT. TO GROUND SURFACE WITH LIMESTONE GRAVEL.
HX CORE	2.0	0	0								VOID 4.65 - 5.0 FT.	
HX CORE	1.0	0	0				503.28	5				
SS 2"	1.5	0	4-3-2 5									
SS 2"	1.4	.3	5-6-9 15								SILTY CLAY AT 7.5 FT.	
HX CORE	2.3	2.3	100				500.38	7.9			7.9 - 10.2 FT. LIMESTONE LIGHT GRAY (N5), FINE GRAINED, NEAR VERTICAL FRACTURE 9.3 - 10.2 FT.	L.P. .0 ROD 100
							498.28	10				
											BOTTOM OF HOLE: 10.2 FEET.	

SS=SPLIT SPOON; ST=SHELBY TUBE; C=CALIFORNIA	SITE	HOLE NO.
	QUARRY	007-C

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP WELDON SPRING	14501	1 OF 1	016-C

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
QUARRY	N 7645 E 13930	90	0

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH (FT.)
10/15/86	10/15/86	BOB HENSON	MOBILE B-80	HX	10	2.1	12.1

CORE RECOVERY(FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
7.0/75	1	6	N.A.	509.50	--	10/499.50

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 LBS./30 IN.	NONE	L.R. WEST

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS / % / PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							509.50					
SS 2"	1.5	1.25	4-12-44 56								0.0 - 10.0 FT. FILL CLAY, SILT, GRAVEL. LIMESTONE BOULDER AT 1.25 FT. CONCRETE AT 3.0 FT.	BACKFILLED TO GROUND SURFACE WITH 3 FT.³ CEMENT.
HX CORE	2.0	1.3	65									
	2.0	1.3	65				504.50	5			5.0 - 7.9 FT. LIMESTONE GRAVEL AND CONCRETE.	
	2.15	1.4	65									
	2.7	2.3	85								VOID 9.5 - 10.0 FT.	
	1.5	1.5	100				499.50	10			10.0 - 12.1 FT. LIMESTONE LIGHT GRAY, (N5), FINE GRAINED, FOSSILIFEROUS, VERTICAL FRACTURE 10.0 - 10.6 FT.	L.P. 1.5 RQD 100
											BOTTOM OF HOLE: 12.1 FEET.	

SS=SPLIT SPOON; ST=SHELBY TUBE; C=CALIFORNIA	SITE	HOLE NO.
	QUARRY	016-C

BECHTEL

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP WELDON SPRING	14501	1 OF 1	009-C

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
QUARRY	N 7570 E 13925	90	0

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH (FT.)
10/16/86	10/17/86	BOB HENSON	SIMCO TR-2	HX	8.6	2.2	10.8

CORE RECOVERY(FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
4.3/52	1		N.A.	508.20	--	8.6/499.60

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 LBS./30 IN.	NONE	L.R. WEST

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLE RECOVERY CORE RECOVERY	SAMPLE BLOWS "N" PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							508.20					
SS 2"	1.5	1.0	2-4-7 11								0.0 - 8.6 FT. FILL SILTY CLAY, SOME LIMESTONE GRAVEL.	BROKE SS AT 3.0 FT.
SS 2"	1.0	.5	6-13-33 43								CONCRETE 2.0 - 2.5 FT.	BACKFILLED TO 6.0 FT. WITH 3 FT.³ CEMENT. 6 FT. TO GROUND SURFACE WITH LIMESTONE GRAVEL.
HX CORE	1.5	.5	33								LIMESTONE GRAVEL 2.5 - 4.0 FT. 4.0 - 6.0 FT. WOOD, SMALL PIECES OF REBAR, STEEL.	
	2.0	1.0	36				503.20	5				
	2.0	.8	40								6.0 - 8.6 FT. ALUMINUM, STEEL AND CONCRETE.	
							499.60	8.6			8.6 - 10.8 FT. LIMESTONE LIGHT GRAY (N5), FINE GRAINED, FOSSILIFEROUS, HIGHLY FRACTURED. SOLUTION ACTIVITY AT 10.4 FT.	L.P. .3 RQD 0
	2.0	2.0	100				498.20	10				
											BOTTOM OF HOLE: 10.8 FEET.	

SS=SPLIT SPOON; ST=SHELBY TUBE; C=CALIFORNIA	SITE	HOLE NO.
	QUARRY	009-C

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP WELDON SPRING	14501	1 OF 1	008-CA

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
QUARRY	N 7667 E 14014	90	0

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH (FT.)
11/24/86	11/24/86	BOB HENSON	MOBILE B-80	HQ	28.5	2.0	30.5

CORE RECOVERY(FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
2/100	1		N.A.	553.43	10/543.43	28.5/524.93

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 LBS./30 IN.	NONE	L.R. WEST

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS or PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES
SS 2"	1.5	.75	3-6-4 10			
SS 2"	1.5	.5	2-2-2 4			
SS 2"	1.5	.5	2-1-4 5			
SS 2"	1.5	0	1-5-6 11			
SS 2"	1.5	0	5-4-2 6			
SS 2"	1.5	0	1-1-4 5			
SS 2"	1.5	.5	4-6-5 11			
SS 2"	1.5	1.5	1-1-2 3			
SS 2"	1.5	1.5	1-1-2 3			
SS 2"	1.5	1.5	2-3-3 6			
SS 2"	1.5	1.5	4-4-8 12			
SS 2"	1.5	1.5	3-6-7 13			
SS 2"	1.5	1.0	5-5-8 13			
SS 2"	1.5	1.2	3-2-2 4			
SS 2"	1.5	1.5	6-14-20 34			
SS 2"	1.5	.5	10-23-15 38			
HX CORE	1.0	1.0	100			
HX CORE	1.0	.4	40			
HX CORE	1.0	.5	50			
SS 2"	1.5	.8	6-21-21 42			
HX CORE	1.0	1.0	100			
HX CORE	1.0	1.0	100			

ELEVATION	DEPTH
553.43	
548.43	5
543.43	10
538.43	15
533.43	20
528.43	25
523.43	30

DEPTH	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
0.0 - 12.0 FT.	<u>FILL</u> SILTY CLAY, BROWN, LIMESTONE GRAVEL. WET, SLIGHTLY PLASTIC AT 6 FT. NO GRAVEL BELOW 6 FT.	BACKFILLED WITH 4.5 FT.^{3} CEMENT.
12.0 - 28.5 FT.	<u>SILTY CLAY</u> BROWN. 22.5 - 25.0 FT. LIMESTONE GRAVEL, AND CLAY, RED BROWN.	
28.5 - 30.5 FT.	<u>LIMESTONE</u> LIGHT GRAY, FINE GRAINED, VUGGY.	RUN 1: L.P. .8, RQD 80 RUN 2: L.P. .78, RQD 78

BOTTOM OF HOLE: 30.5 FEET.

SS=SPLIT SPOON; ST=SHELBY TUBE; C=CALIFORNIA

SITE	HOLE NO.
QUARRY	008-CA

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP WELDON SPRING	14501	1 OF 1	808-C

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
QUARRY	N 7690 E 14040	90	0

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH (FT.)
11/21/86	11/21/86	BOB HENSON	MOBILE B-80	HX	25.5	0	25.5

CORE RECOVERY(FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
N.A.	N.A.		N.A.	555.23	--	N.A.

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 LBS./30 IN.	NONE	L.R. WEST

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLE RECOVERY CORE RECOVERY	SAMPLE BLOWS or PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH
							555.23	
SS 2"	1.5	.5	3-8-5 11					
SS 2"	1.5	0	4-4-3 7					
SS 2"	1.5	.3	2-3-4 7					
SS 2"	1.5	1.0	4-8-7 15				550.23	5
SS 2"	1.5	.88	7-6-5 11					
SS 2"	1.5	.58	1-2-1 3					
SS 2"	1.5	.85	3-3-3 6				545.23	10
SS 2"	1.5	.85	1-4-6 10					
SS 2"	1.5	.67	1-1-2 3					
SS 2"	1.5	.94	2-3-4 7				540.23	15
SS 2"	1.5	1.2	3-3-5 8					
SS 2"	1.5	1.5	5-5-5 10					
SS 2"	1.5	1.0	4-4-4 8				535.23	20
SS 2"	1.5	1.42	4-4-5 9					
SS 2"	1.5	.85	4-5-5 10					
SS 2"	1.5	1.5	2-5-7 12					
SS 2"	1.5	1.5	6-6-15 21				530.23	25

DESCRIPTION AND CLASSIFICATION

0.0 - 15.0 FT. FILL
SILTY CLAY, BROWN; AND GRAVEL. LIMESTONE GRAVEL.
GLASS AT 2.0 FT.

15.0 - 25.5 FT. SILTY CLAY
BROWN, SEMI-PLASTIC UNDISTURBED MATERIAL.

BOTTOM OF HOLE: 25.5 FEET.

NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.

BACKFILLED WITH 2.5 FT.^{3} CEMENT/ BENTONITE GROUT.

SS=SPLIT SPOON; ST=SHELBY TUBE; C=CALIFORNIA	SITE: QUARRY	HOLE NO. 808-C

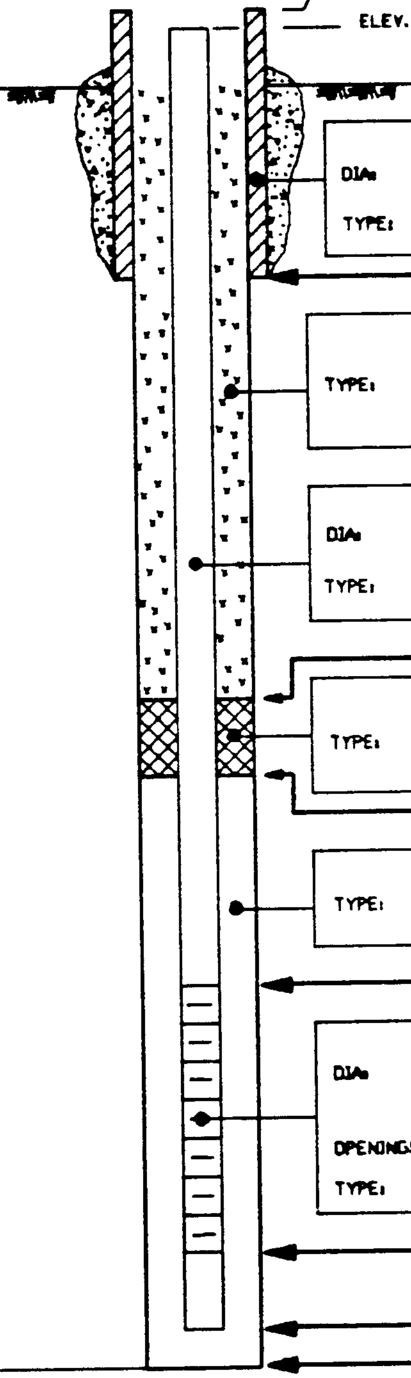
OBSERVATION WELL

PROJECT	WELL NO.
FUSRAP WELDON SPRING	TW-N

JOB NO.	SITE	COORDINATES
14501	QUARRY	N 7896 E 13633

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
12/11/86	12/15/86	L.R. WEST	TOP OF 2 INCH STAINLESS STEEL CASING

GENERALIZED GEOLOGIC LOG



ELEV. - TOP OF SURFACE CASING: 532.63

ELEV. - TOP OF RISER CASING: 532.30

	DEPTH (FT)	ELEV. (FT)
GROUND SURFACE	0	530.96
BOTTOM OF SURFACE CASING	3.33	527.63
TOP OF SEAL	65	465.96
TOP OF FILTER PACK	68	462.96
TOP OF SCREEN	79	451.96
BOTTOM OF SCREEN	89	441.96
BOTTOM OF SUMP	90	440.96
BOTTOM OF HOLE	91	439.96

SURFACE CASING

DIA: 6 INCH SQUARE

TYPE: STEEL

BACKFILL MATERIAL

TYPE: 1:1 CEMENT/WATER WITH 2.5 LBS. BENTONITE PER SACK CEMENT

RISER CASING

DIA: 2 INCH

TYPE: STAINLESS STEEL

ANNULAR SEAL

TYPE: BENTONITE

FILTER PACK

TYPE: OZARK SPECIAL SAND NO. 40

SCREEN:

DIA: 2 INCHES

TYPE: STAINLESS STEEL

OPENINGS: WIDTH: 0.01 INCH

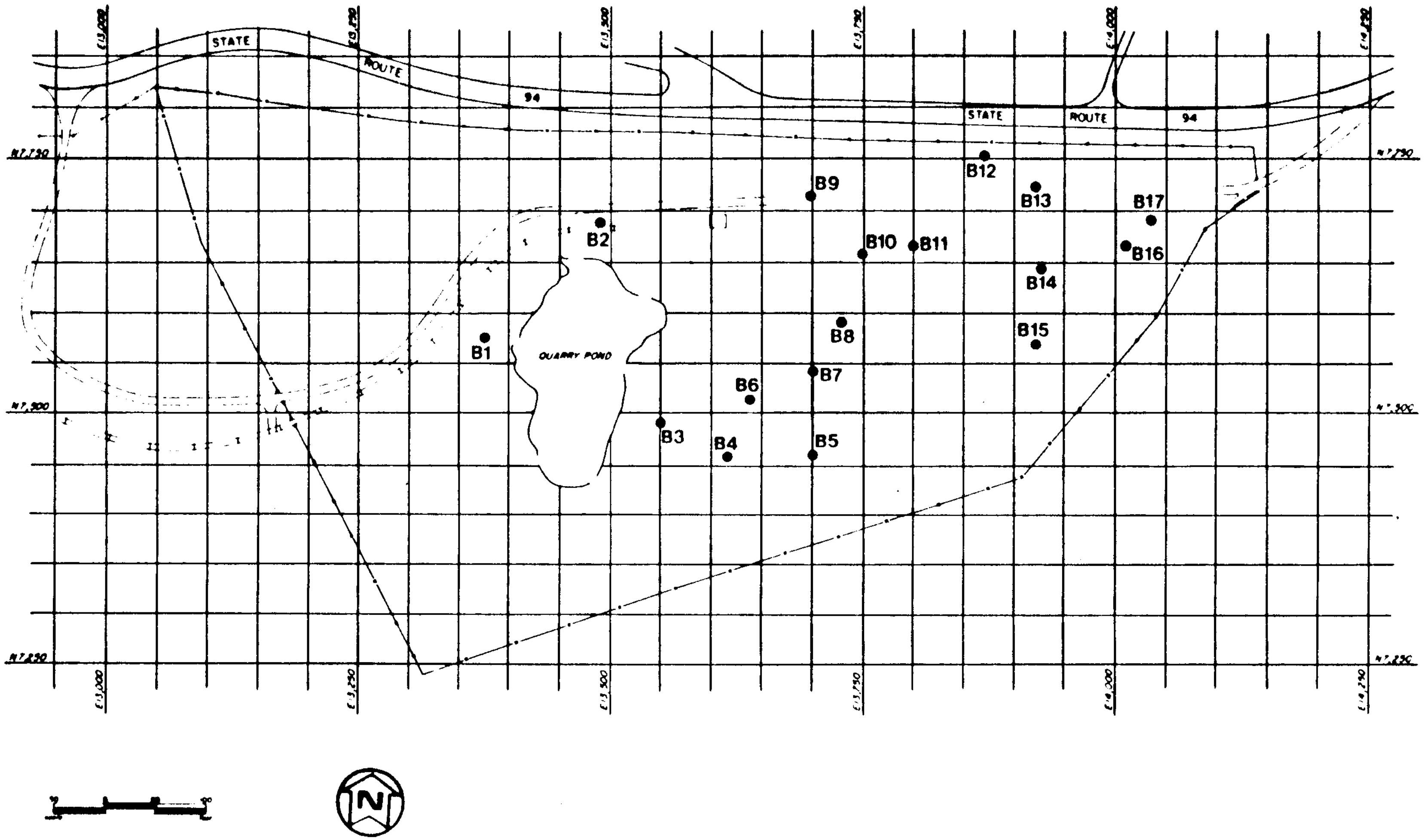
TYPE: JOHNSON WIRE WRAP

HOLE DIA: 8.5 INCHES

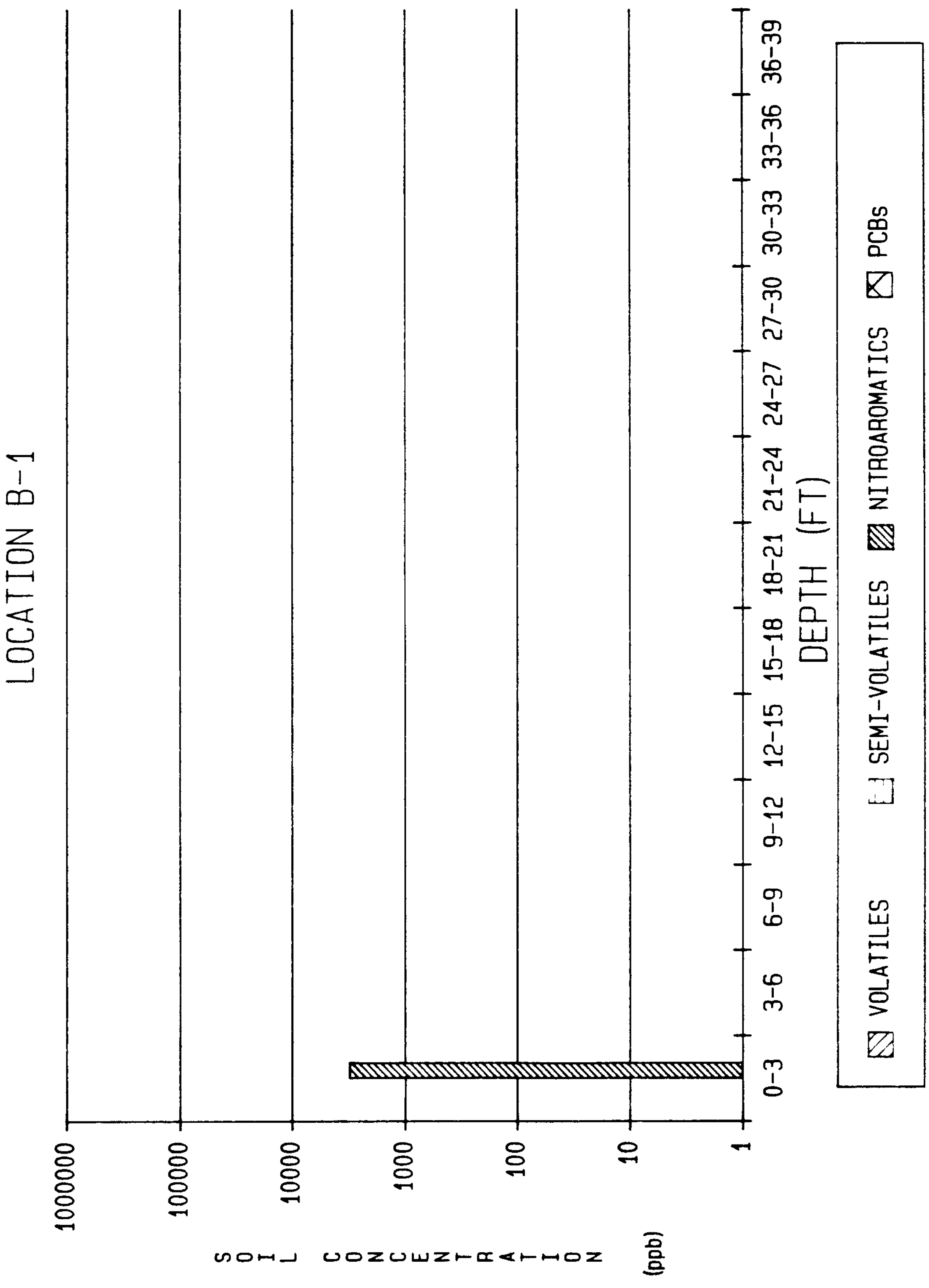
APPENDIX B

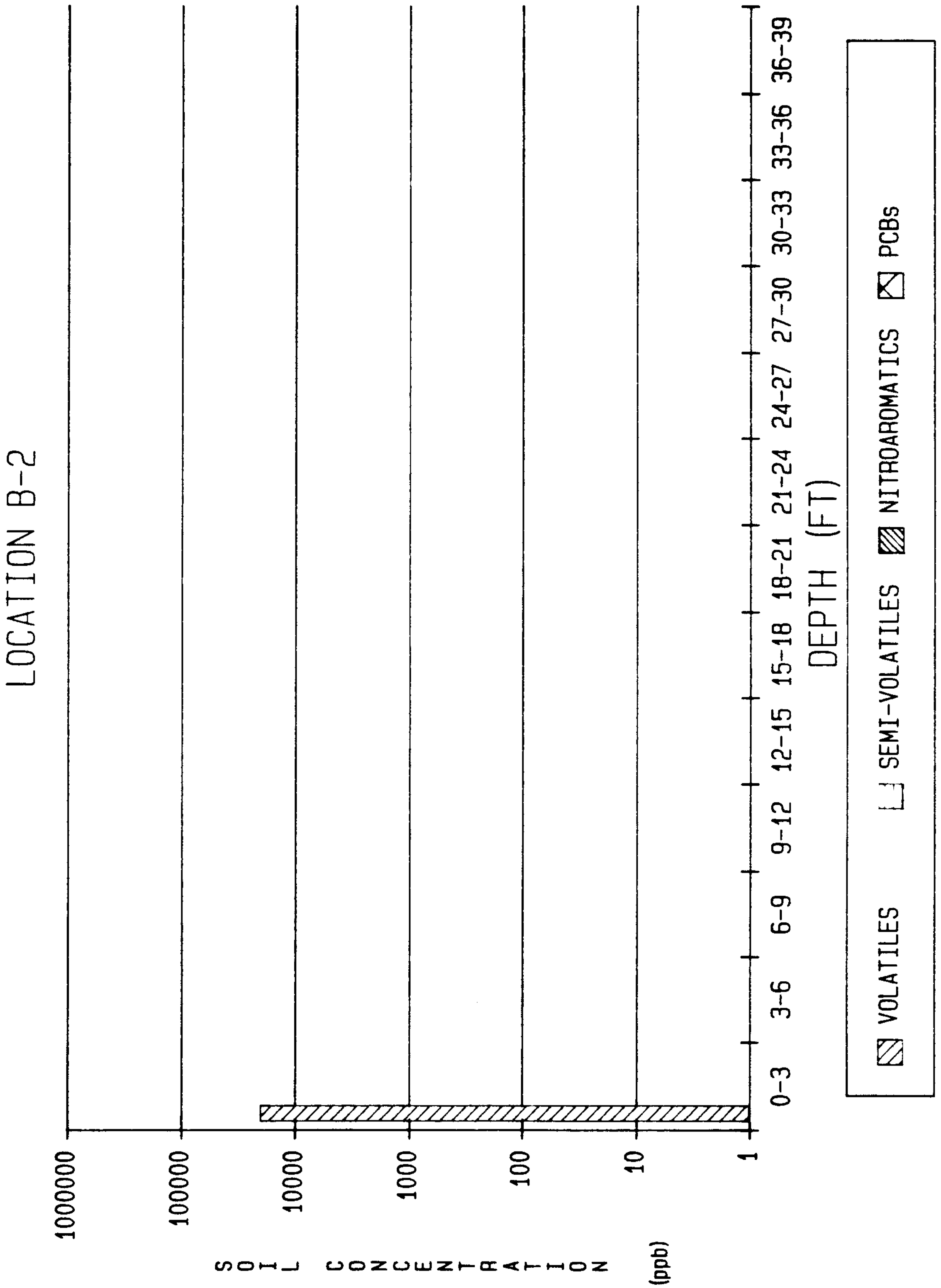
VERTICAL DISTRIBUTION OF CHEMICALS IN EACH BOREHOLE

The sample intervals of the following borehole bar charts have been assigned to standardized depth interval ranges (0 - 3 ft, 3 - 6 ft, etc.). For actual sample depths, refer to Table 5-6 and Tables 5-8 through 5-11. A map has been included to show the locations of the boreholes.

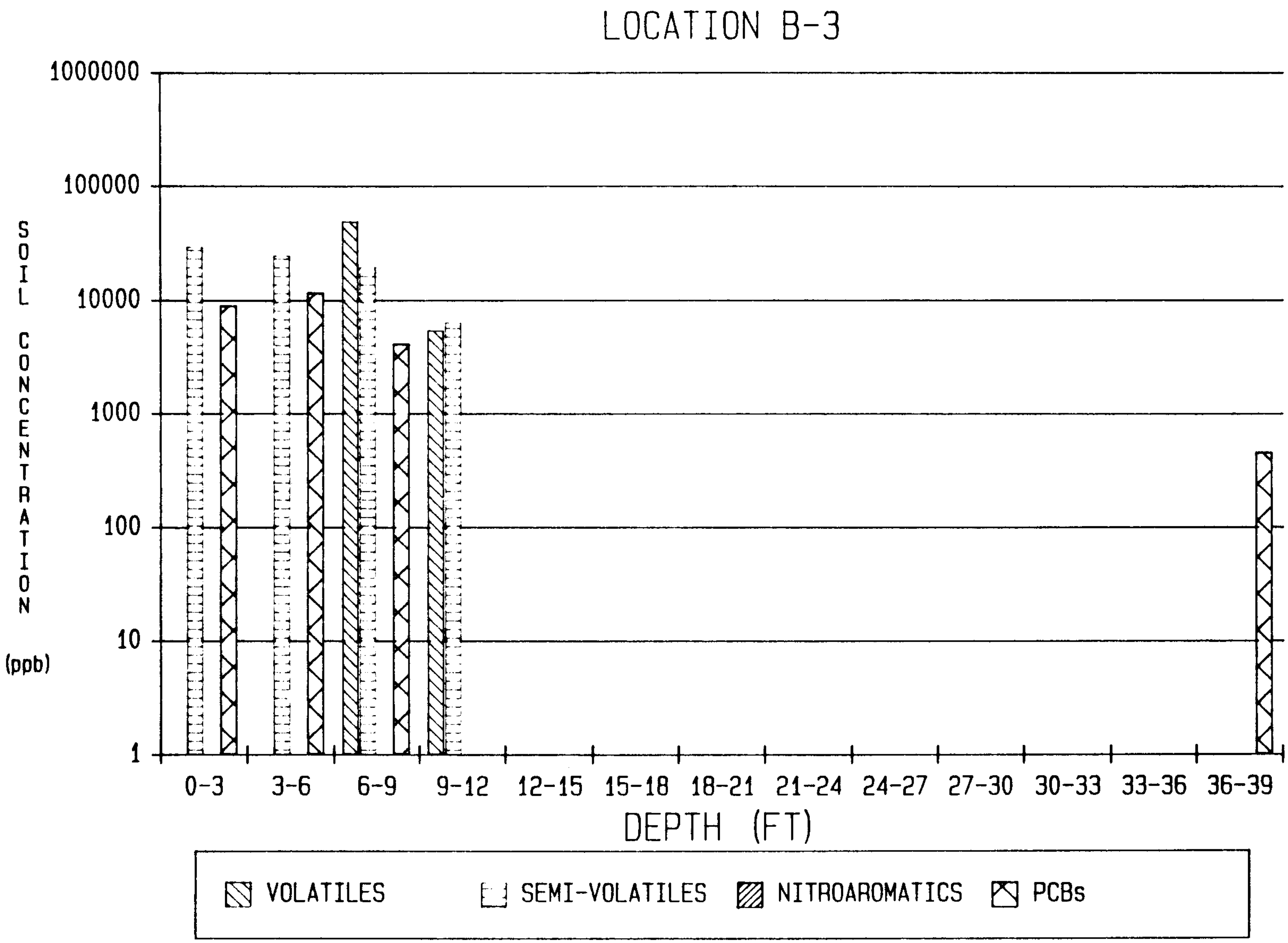


SAMPLING LOCATIONS AT THE WSQ

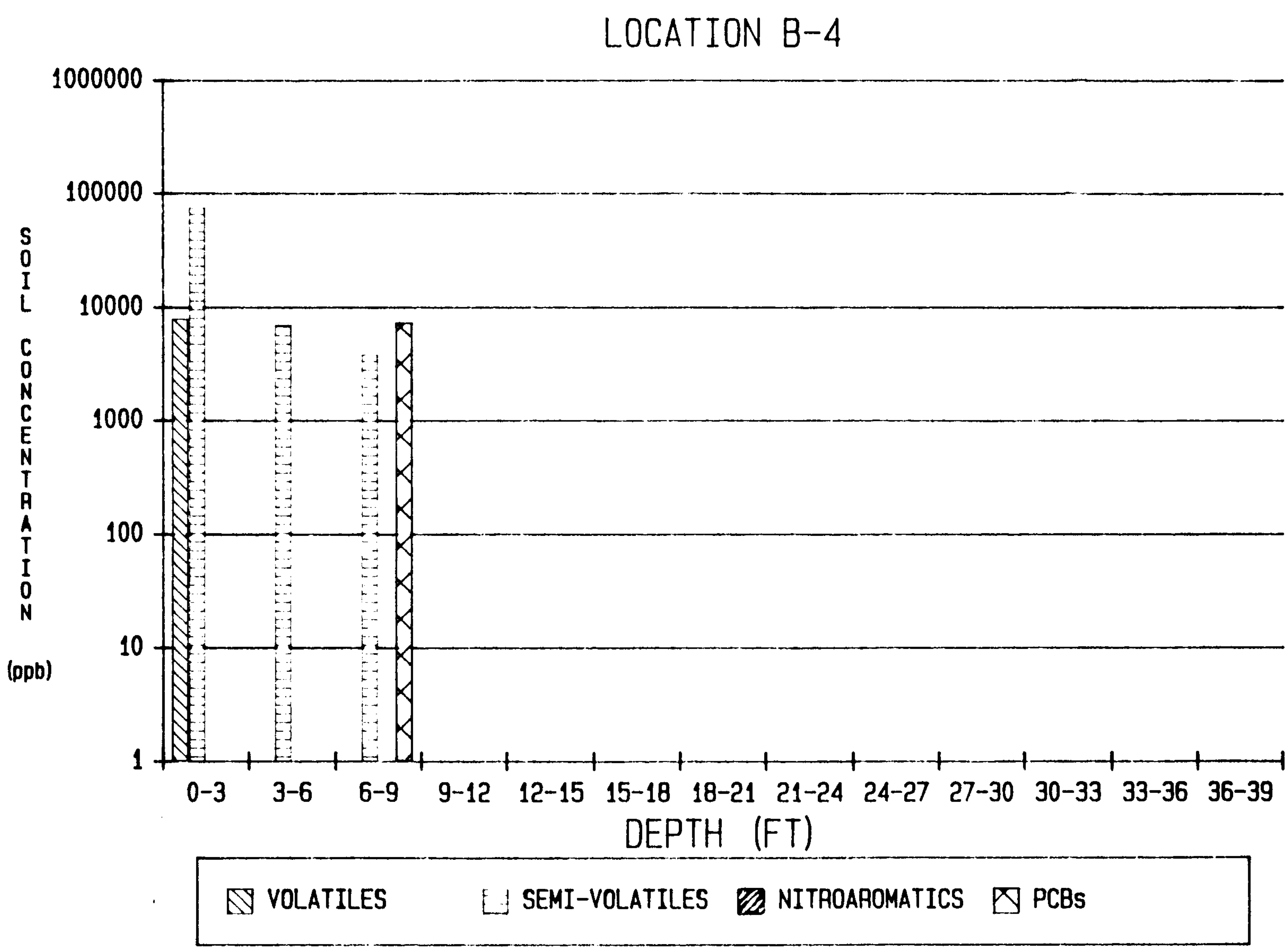

LOCATION B-1
SOIL CONCENTRATION (ppb)
1000000
100000
10000
1000
100
10
1
0-3
3-6
6-9
9-12
12-15
15-18
18-21
21-24
24-27
27-30
30-33
33-36
36-39
DEPTH (FT)
VOLATILES
SEMI-VOLATILES
NITROAROMATICS
PCBs

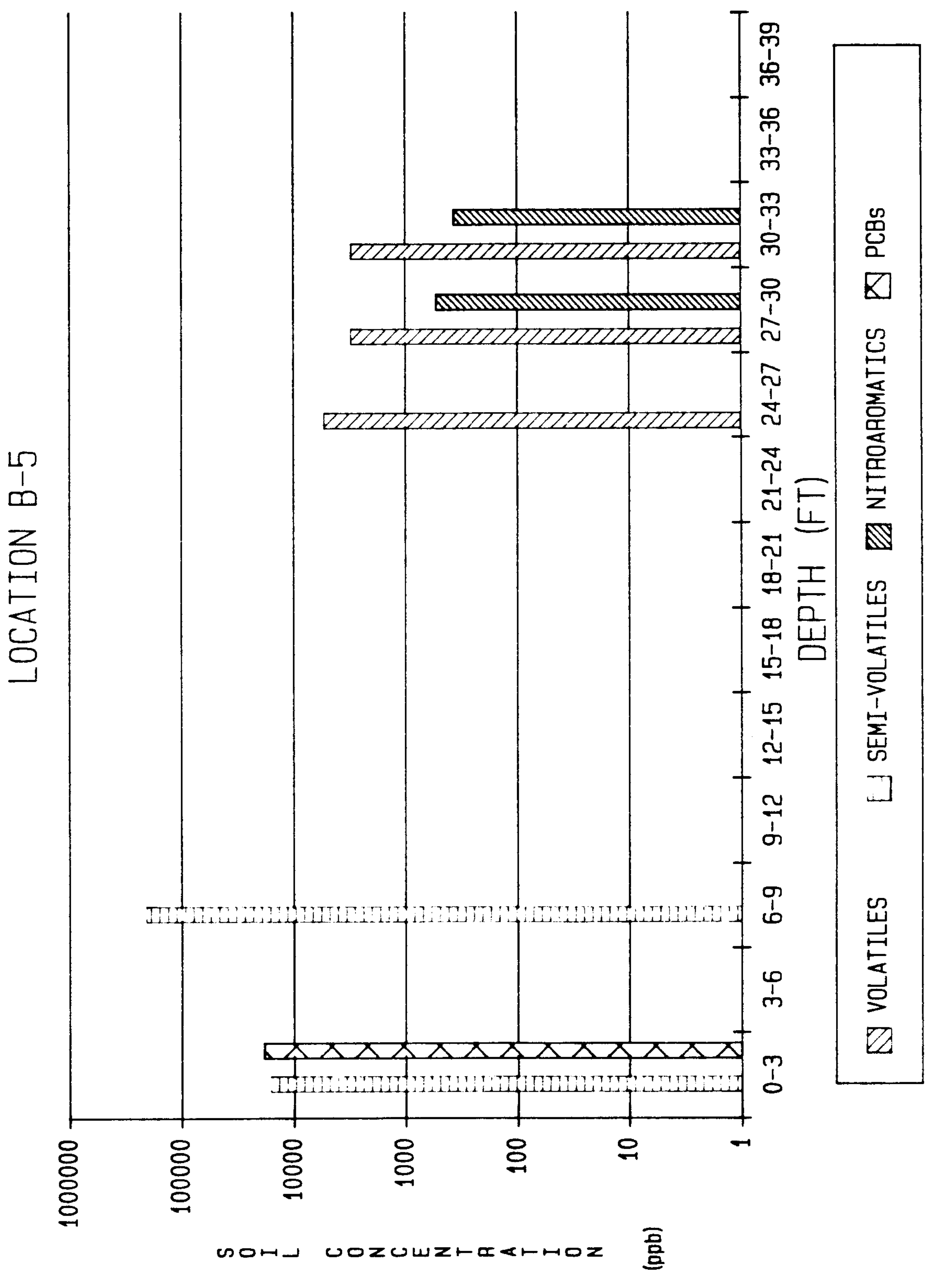


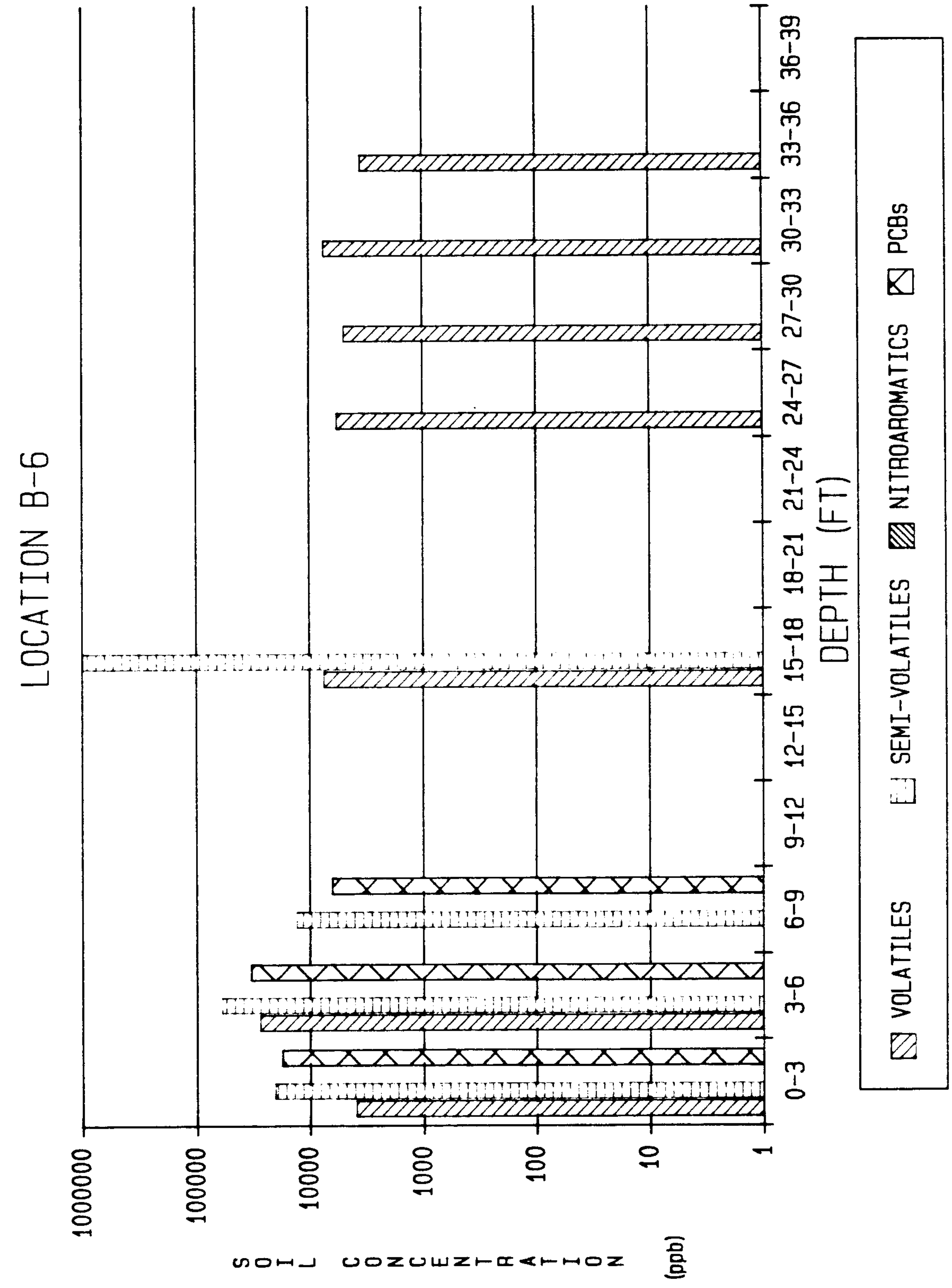
LOCATION B-2
SOIL CONCENTRATION (ppb)
1000000
100000
10000
1000
100
10
1
0-3
3-6
6-9
9-12
12-15
15-18
18-21
21-24
24-27
27-30
30-33
33-36
36-39
DEPTH (FT)
VOLATILES
SEMI-VOLATILES
NITROAROMATICS
PCBs



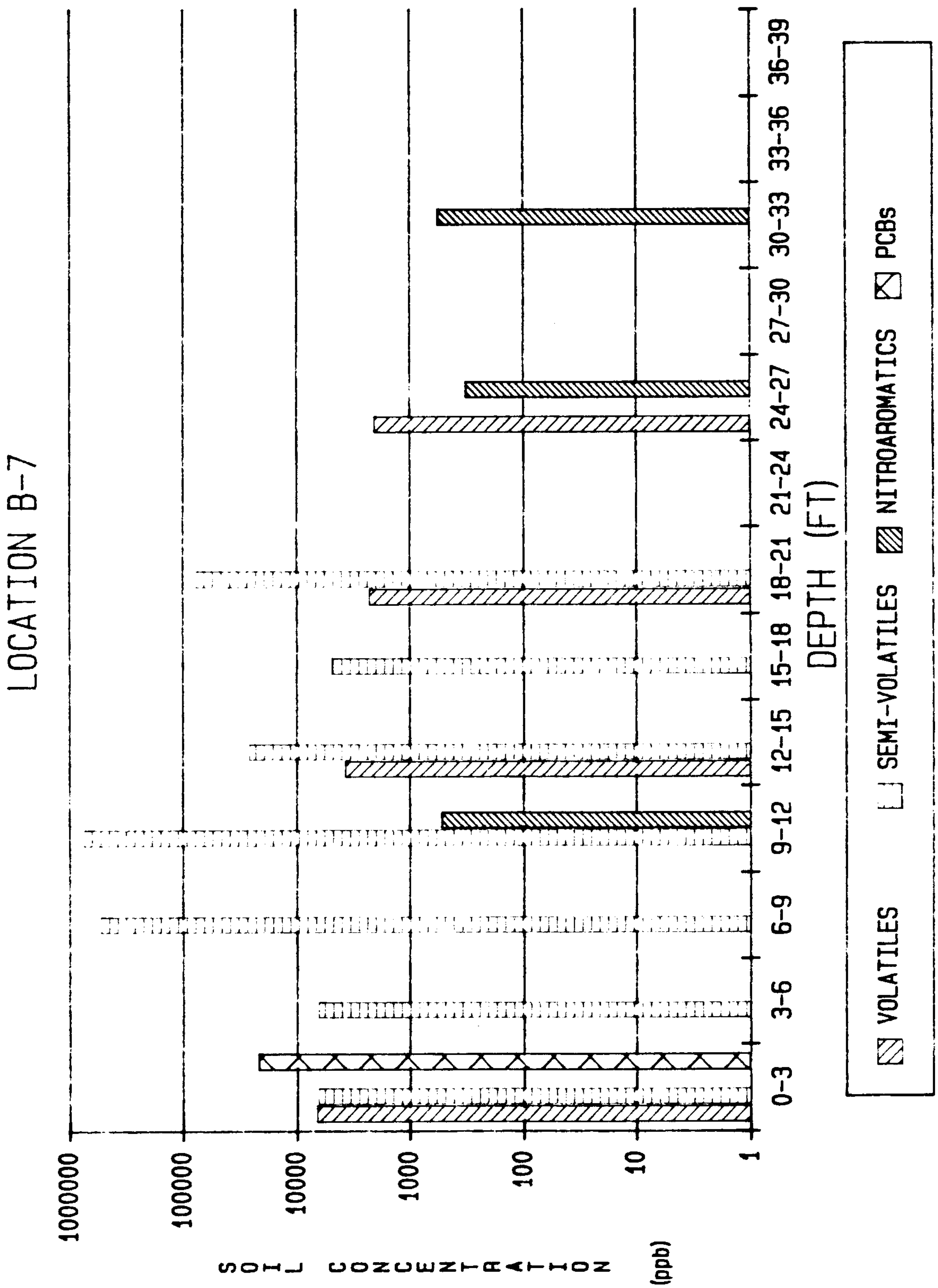
LOCATION B-3
1000000
100000
10000
1000
100
10
1
SOIL CONCENTRATION
(ppb)
0-3
3-6
6-9
9-12
12-15
15-18
18-21
21-24
24-27
27-30
30-33
33-36
36-39
DEPTH (FT)
VOLATILES
SEMI-VOLATILES
NITROAROMATICS
PCBs

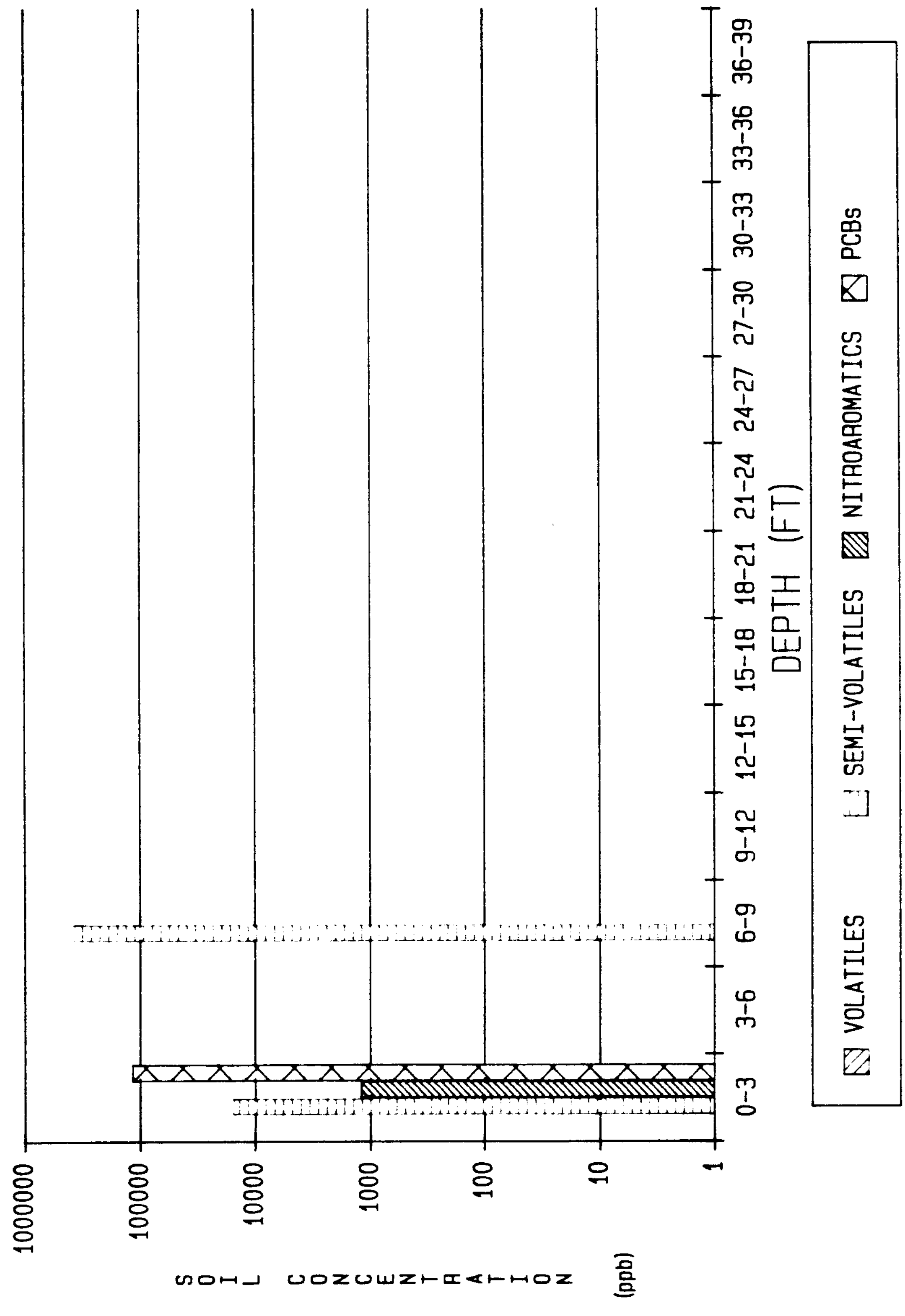

LOCATION B-4
1000000
100000
10000
1000
100
10
1
SOIL CONCENTRATION (ppb)
0-3
3-6
6-9
9-12
12-15
15-18
18-21
21-24
24-27
27-30
30-33
33-36
36-39
DEPTH (FT)
VOLATILES
SEMI-VOLATILES
NITROAROMATICS
PCBs

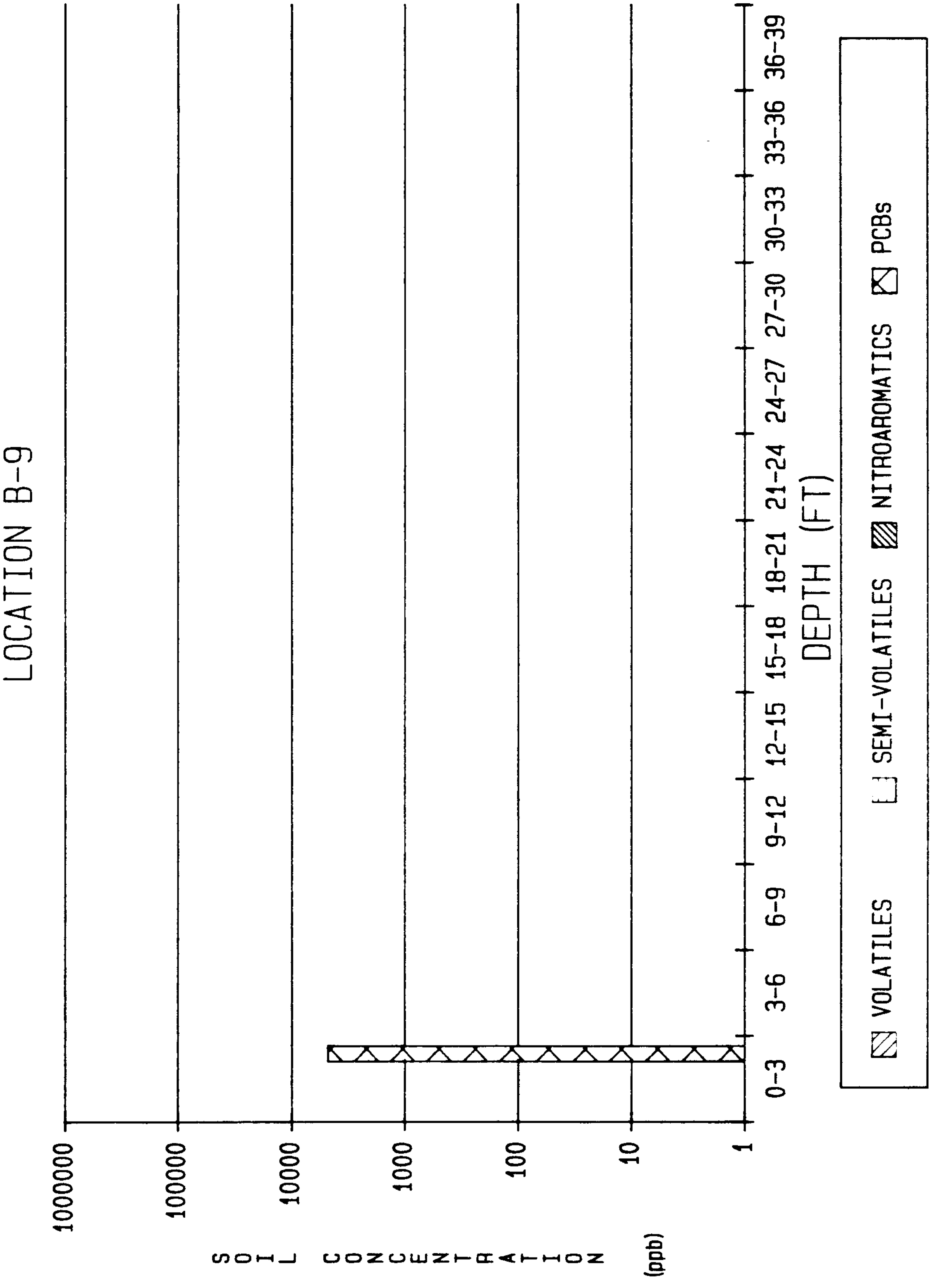

LOCATION B-5
SOIL CONCENTRATION (ppb)
1000000
100000
10000
1000
100
10
1
DEPTH (FT)
0-3
3-6
6-9
9-12
12-15
15-18
18-21
21-24
24-27
27-30
30-33
33-36
36-39
VOLATILES
SEMI-VOLATILES
NITROAROMATICS
PCBs



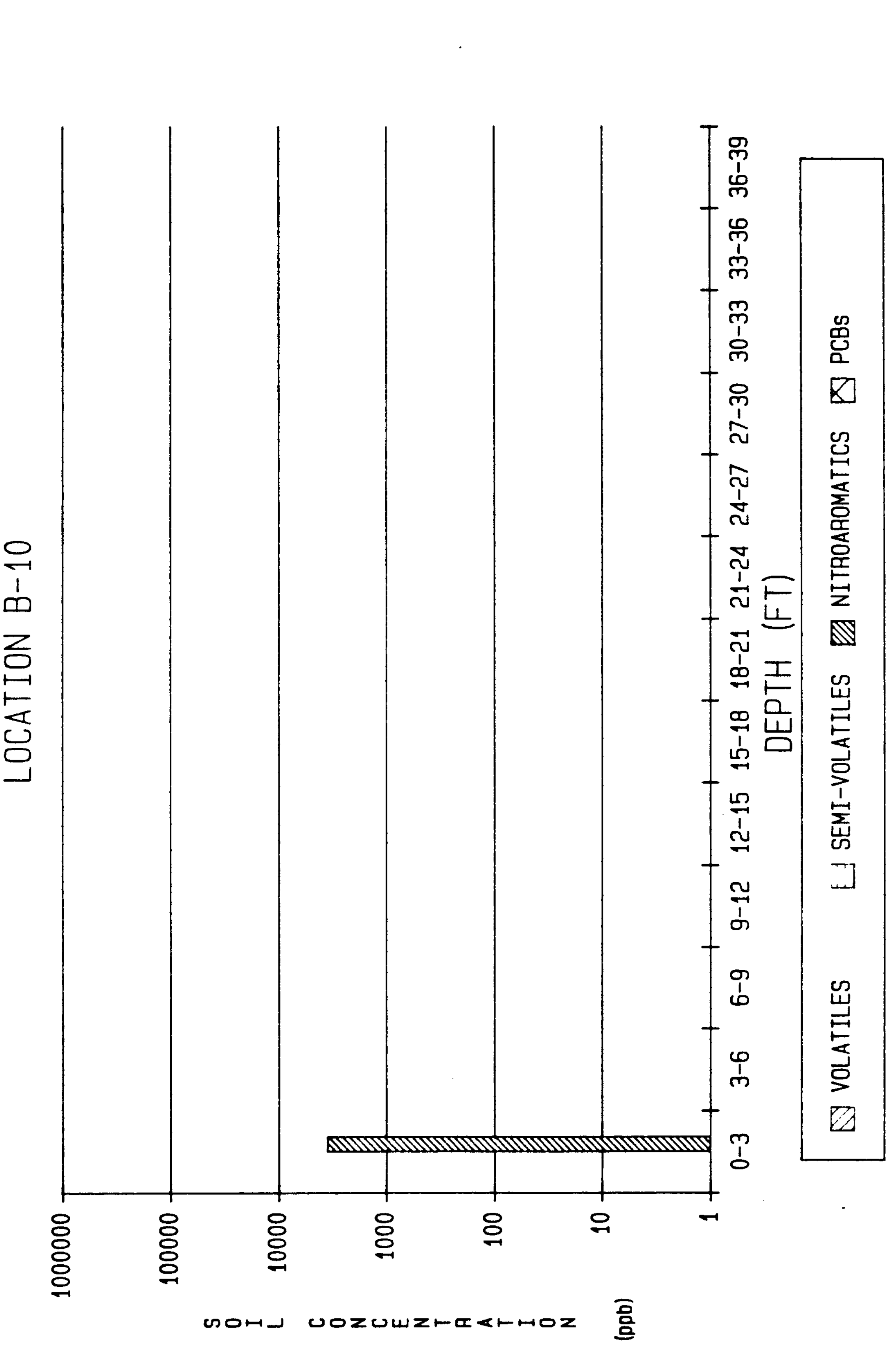
LOCATION B-6
SOIL CONCENTRATION (ppb)
1000000
100000
10000
1000
100
10
1
0-3
3-6
6-9
9-12
12-15
15-18
18-21
21-24
24-27
27-30
30-33
33-36
36-39
DEPTH (FT)
VOLATILES
SEMI-VOLATILES
NITROAROMATICS
PCBs

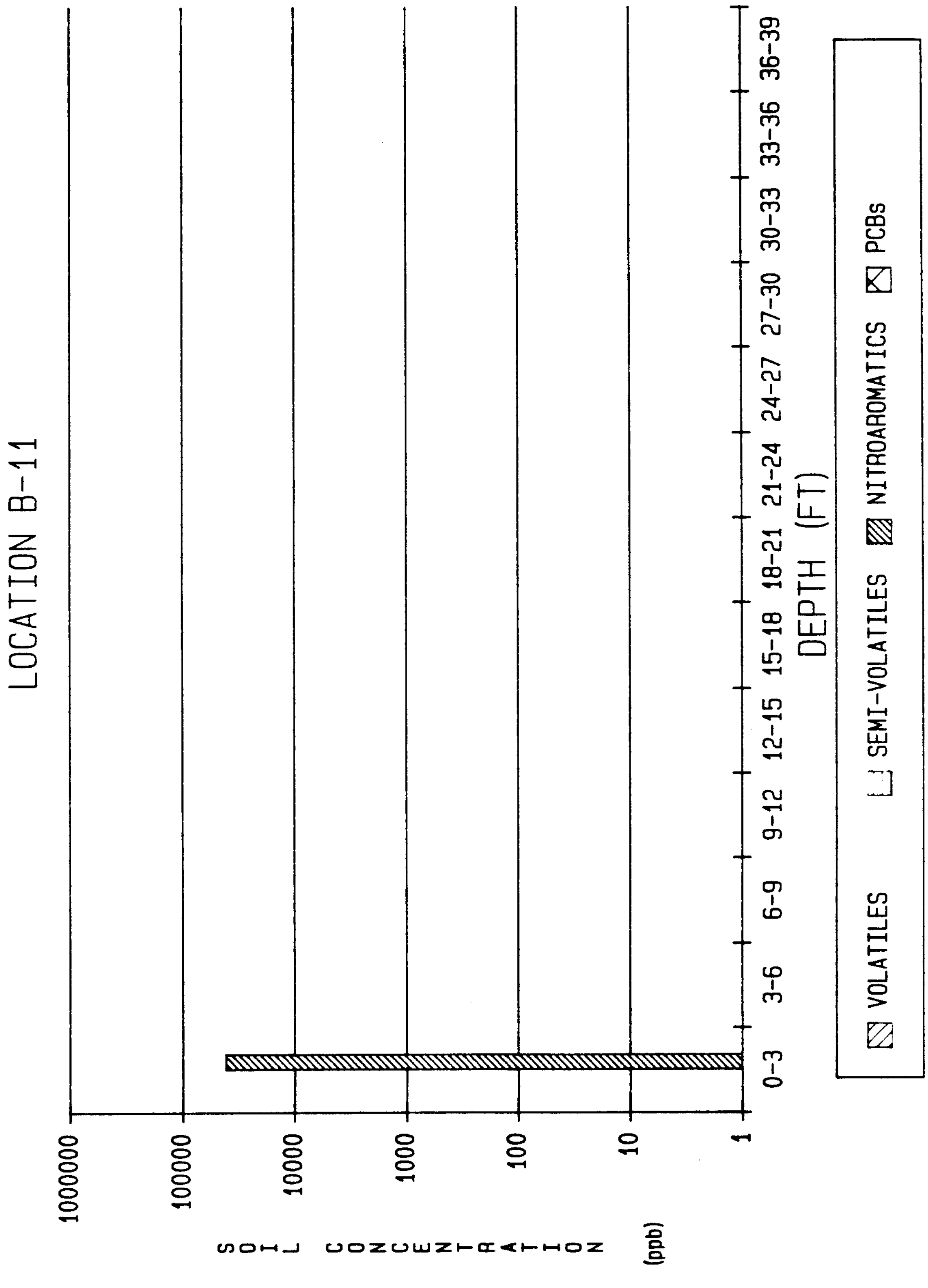

LOCATION B-7
SOIL CONCENTRATION (ppb)
1000000
100000
10000
1000
100
10
1
0-3
3-6
6-9
9-12
12-15
15-18
18-21
21-24
24-27
27-30
30-33
33-36
36-39
DEPTH (FT)
VOLATILES
SEMI-VOLATILES
NITROAROMATICS
PCBs

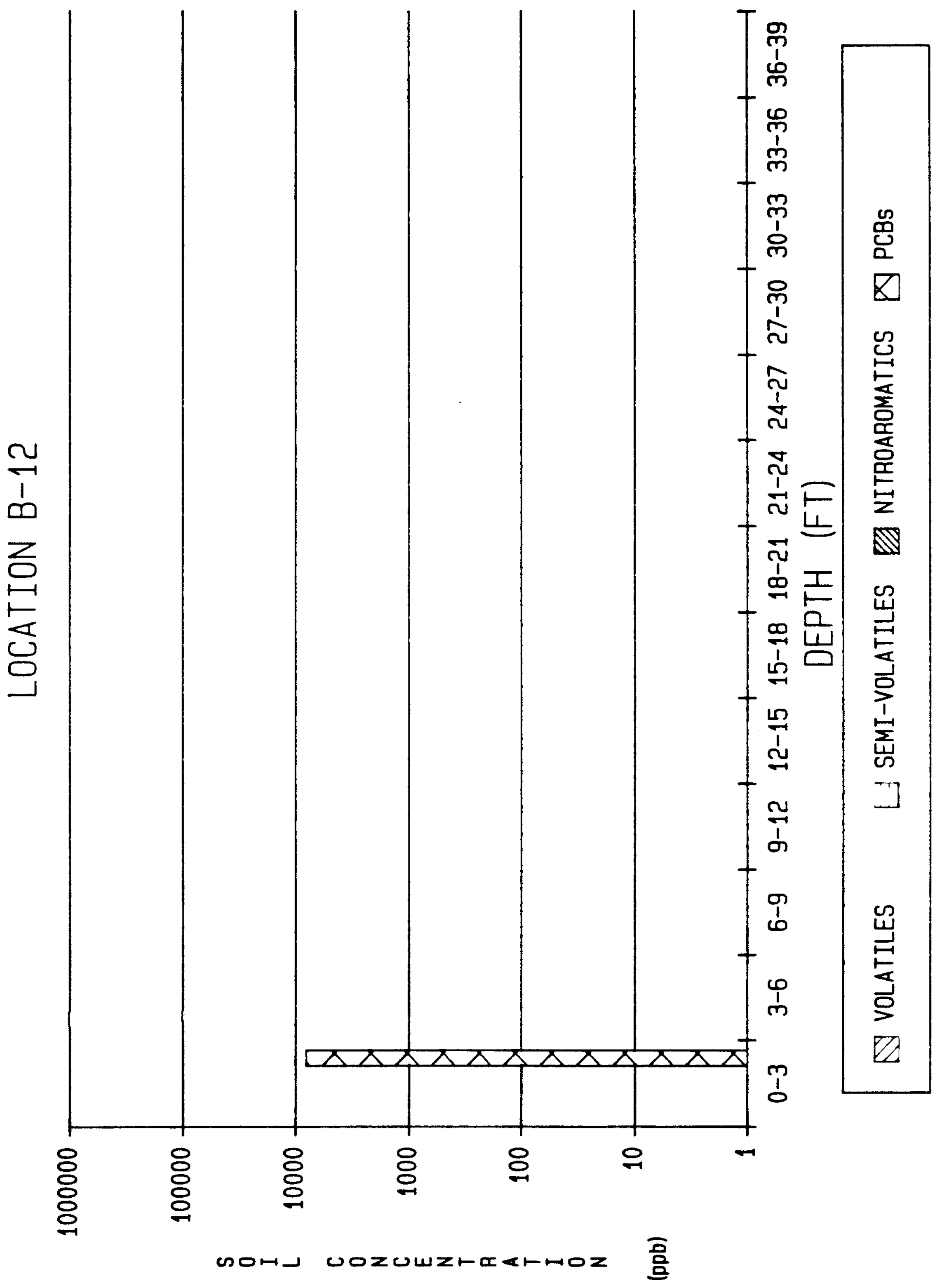

LOCATION B-8
SOIL CONCENTRATION (ppb)
1000000
100000
10000
1000
100
10
1
0-3
3-6
6-9
9-12
12-15
15-18
18-21
21-24
24-27
27-30
30-33
33-36
36-39
DEPTH (FT)
VOLATILES
SEMI-VOLATILES
NITROAROMATICS
PCBs

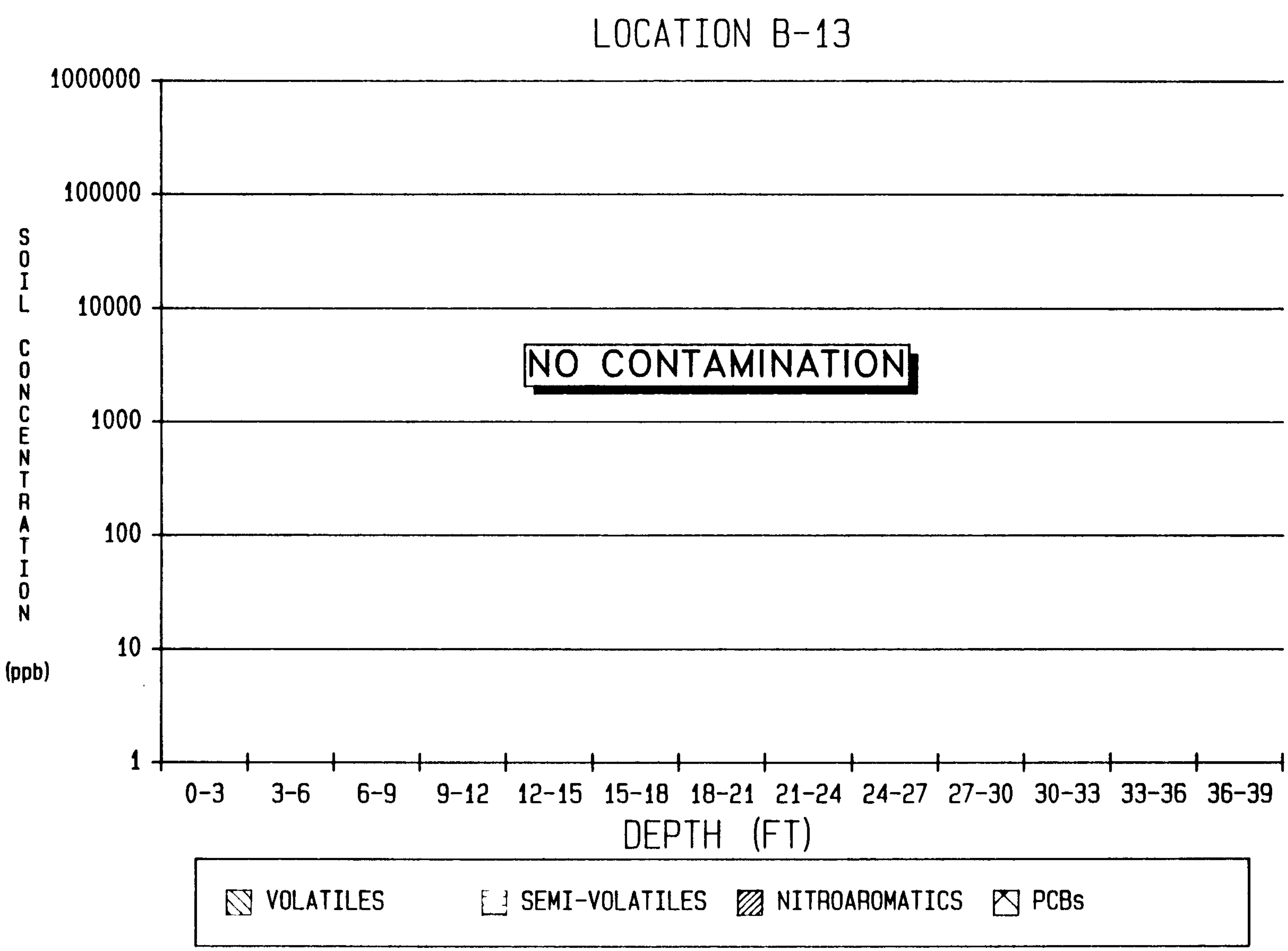


LOCATION B-9
SOIL CONCENTRATION (ppb)
1000000
100000
10000
1000
100
10
1
0-3
3-6
6-9
9-12
12-15
15-18
18-21
21-24
24-27
27-30
30-33
33-36
36-39
DEPTH (FT)
VOLATILES
SEMI-VOLATILES
NITROAROMATICS
PCBs

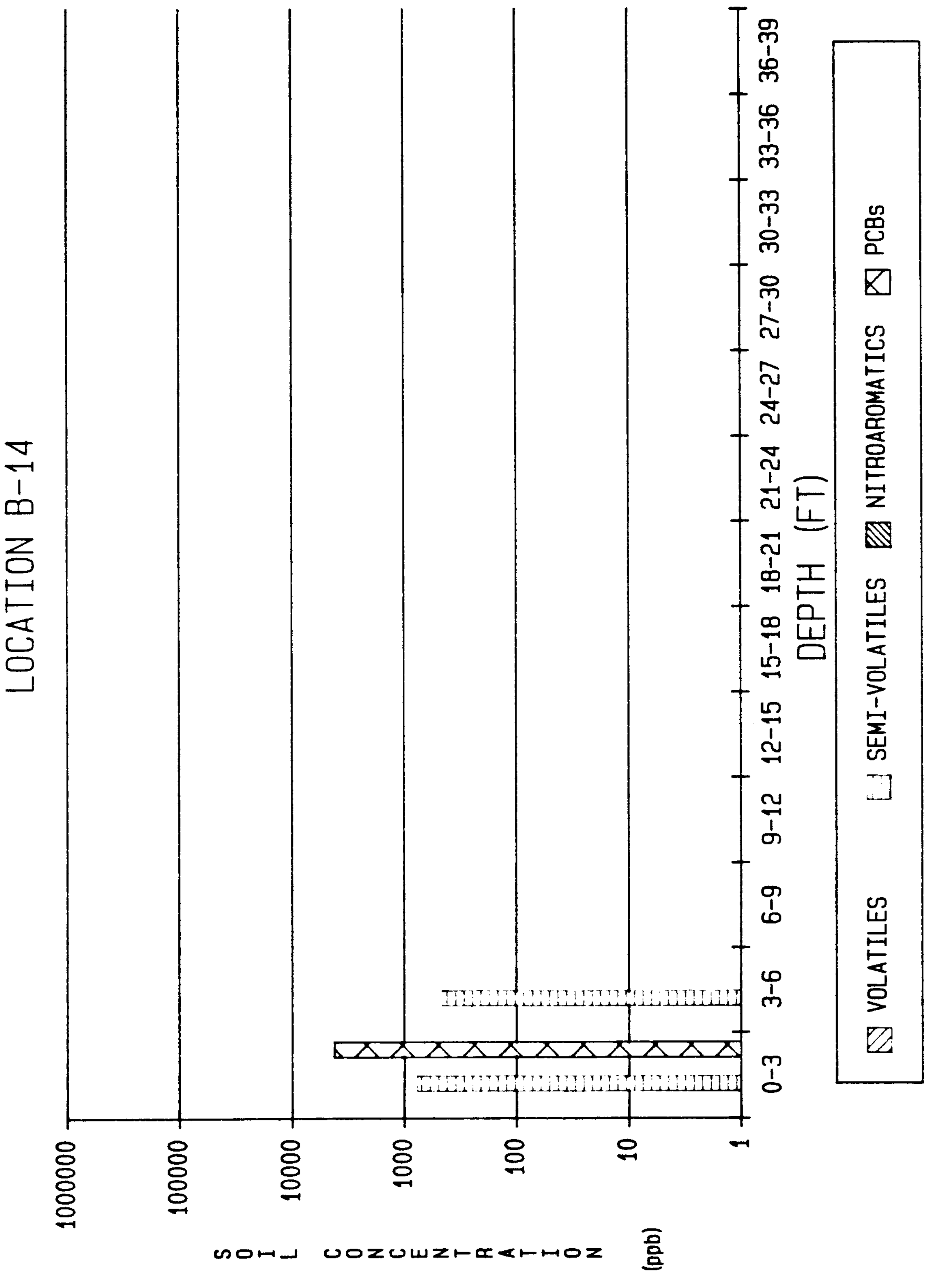

LOCATION B-10
SOIL CONCENTRATION (ppb)
1000000
100000
10000
1000
100
10
1
0-3
3-6
6-9
9-12
12-15
15-18
18-21
21-24
24-27
27-30
30-33
33-36
36-39
DEPTH (FT)
VOLATILES
SEMI-VOLATILES
NITROAROMATICS
PCBs

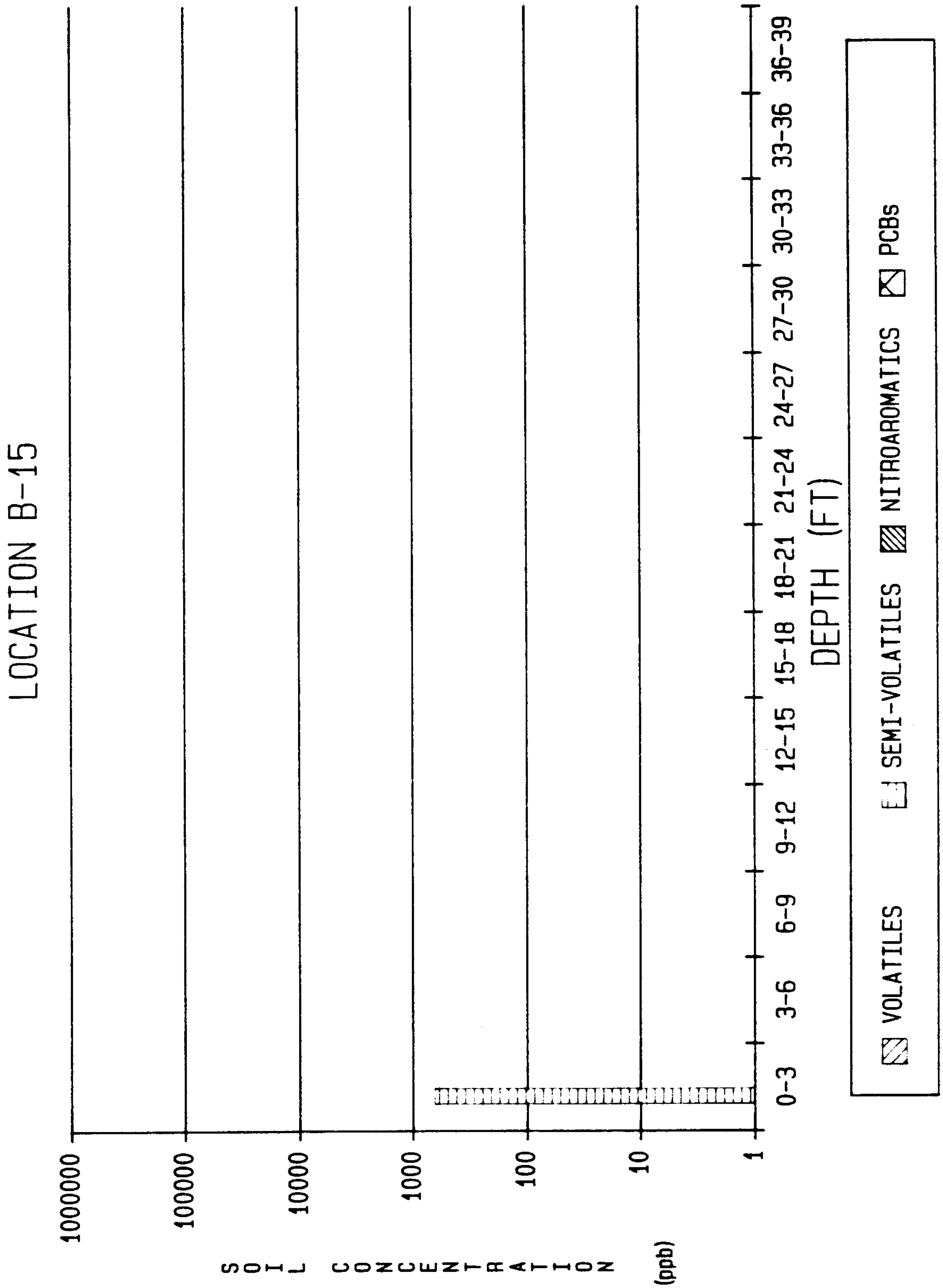

LOCATION B-11
SOIL CONCENTRATION (ppb)
1000000
100000
10000
1000
100
10
1
DEPTH (FT)
0-3
3-6
6-9
9-12
12-15
15-18
18-21
21-24
24-27
27-30
30-33
33-36
36-39
VOLATILES
SEMI-VOLATILES
NITROAROMATICS
PCBs

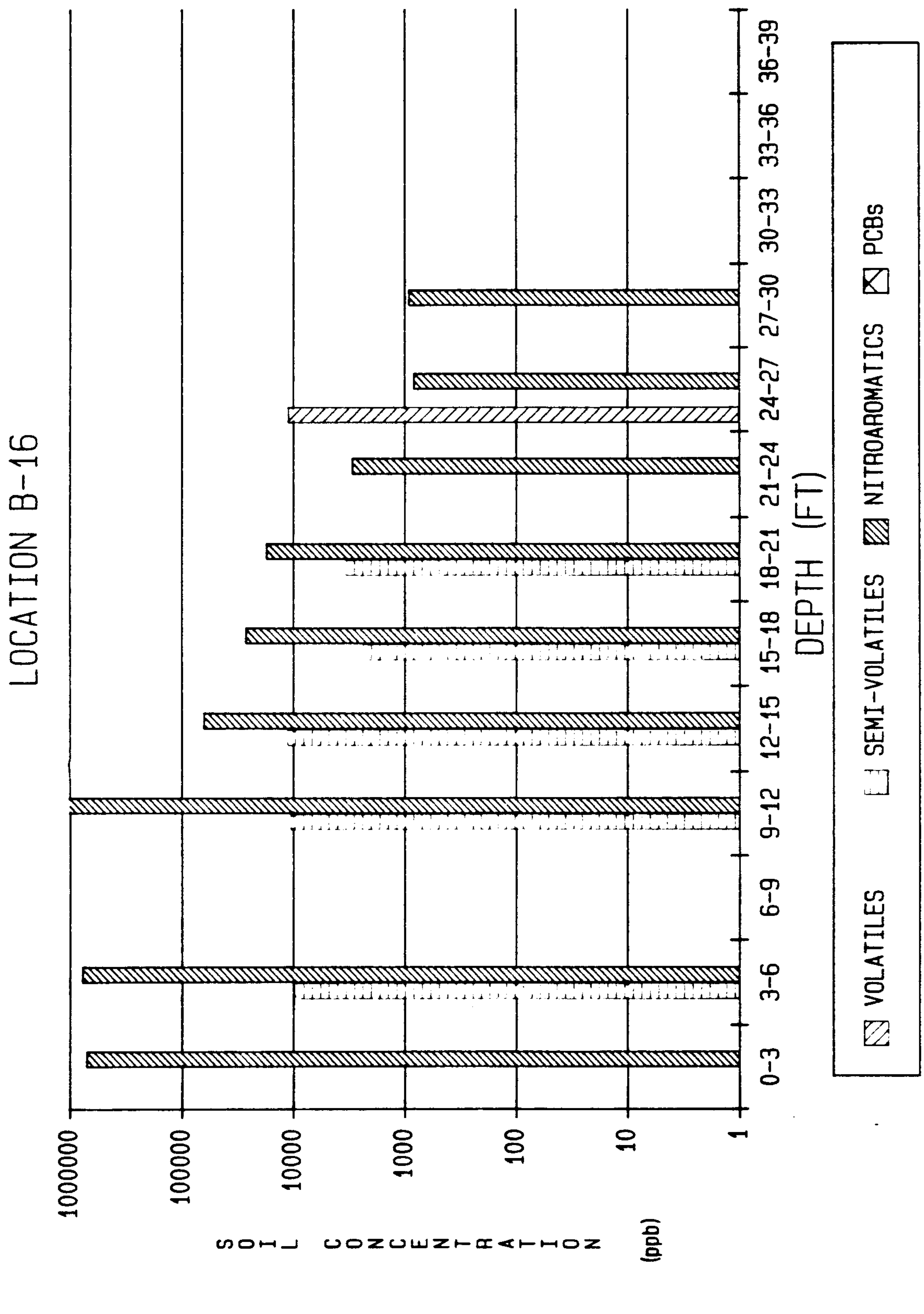

LOCATION B-12
SOIL CONCENTRATION (ppb)
1000000
100000
10000
1000
100
10
1
0-3
3-6
6-9
9-12
12-15
15-18
18-21
21-24
24-27
27-30
30-33
33-36
36-39
DEPTH (FT)
VOLATILES
SEMI-VOLATILES
NITROAROMATICS
PCBs



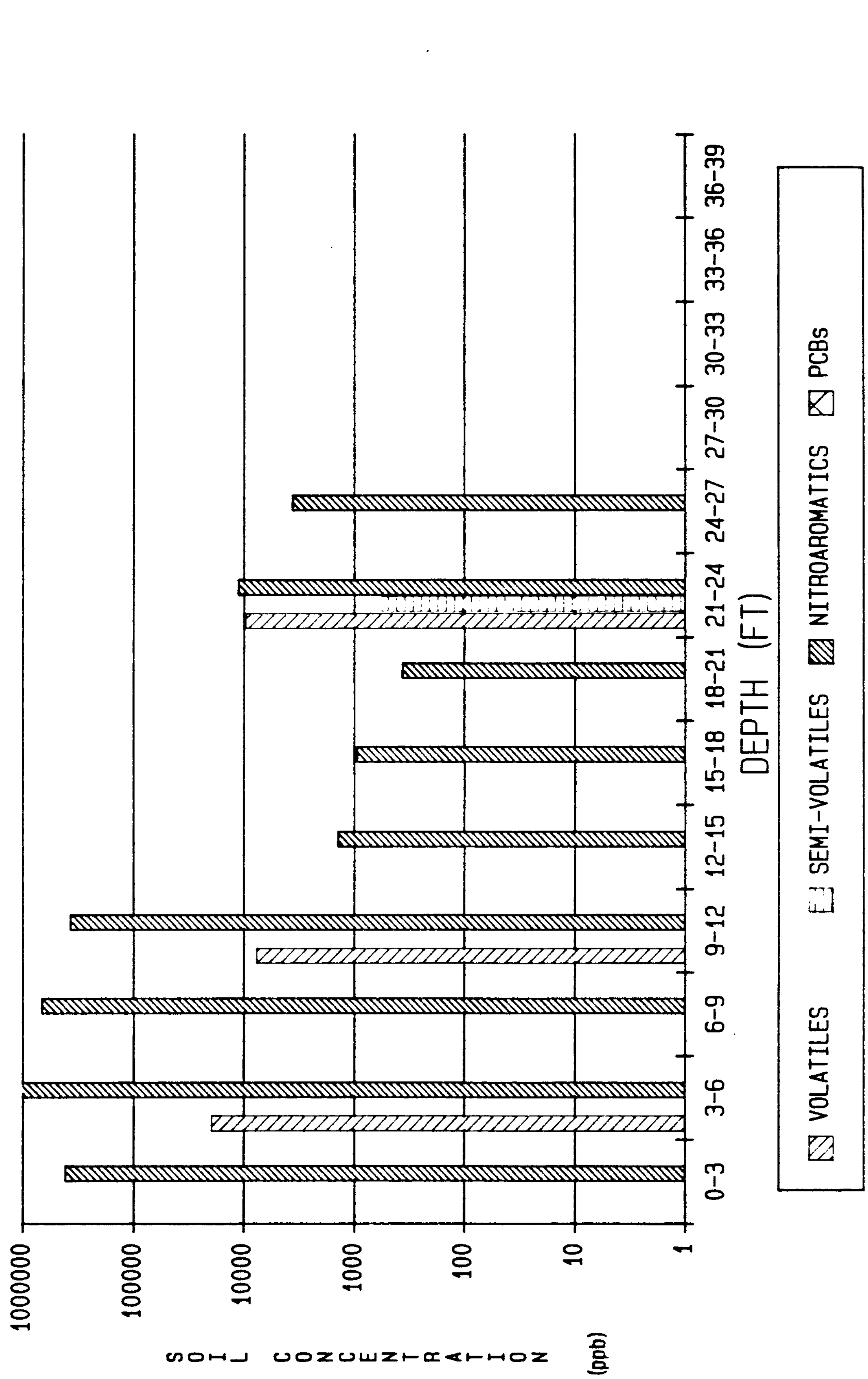
LOCATION B-13
1000000
100000
10000
1000
100
10
1
SOIL CONCENTRATION (ppb)
NO CONTAMINATION
0-3
3-6
6-9
9-12
12-15
15-18
18-21
21-24
24-27
27-30
30-33
33-36
36-39
DEPTH (FT)
VOLATILES
SEMI-VOLATILES
NITROAROMATICS
PCBs


LOCATION B-14
SOIL CONCENTRATION (ppb)
1000000
100000
10000
1000
100
10
1
0-3
3-6
6-9
9-12
12-15
15-18
18-21
21-24
24-27
27-30
30-33
33-36
36-39
DEPTH (FT)
VOLATILES
SEMI-VOLATILES
NITROAROMATICS
PCBs


LOCATION B-15
SOIL CONCENTRATION (ppb)
1000000
100000
10000
1000
100
10
1
0-3
3-6
6-9
9-12
12-15
15-18
18-21
21-24
24-27
27-30
30-33
33-36
36-39
DEPTH (FT)
VOLATILES
SEMI-VOLATILES
NITROAROMATICS
PCBs



LOCATION B-16
SOIL CONCENTRATION (ppb)
1000000
100000
10000
1000
100
10
1
DEPTH (FT)
0-3
3-6
6-9
9-12
12-15
15-18
18-21
21-24
24-27
27-30
30-33
33-36
36-39
VOLATILES
SEMI-VOLATILES
NITROAROMATICS
PCBs


LOCATION B-17
SOIL CONCENTRATION (ppb)
1000000
100000
10000
1000
100
10
1
0-3
3-6
6-9
9-12
12-15
15-18
18-21
21-24
24-27
27-30
30-33
33-36
36-39
DEPTH (FT)
VOLATILES
SEMI-VOLATILES
NITROAROMATICS
PCBs

Department of Energy
Oak Ridge Operations
Weldon Spring Site
Remedial Action Project Office
Route 2, Highway 94 South
St. Charles, Missouri 63303

November 17, 1988

ADDRESSEES

ASSESSMENT OF DROUGHT CONDITIONS AT THE WELDON SPRING QUARRY

The Department of Energy completed an assessment of the effects of the drought on contaminant migration from the Weldon Spring Quarry. The results are presented in the final report entitled "Initial Assessment of the Effect of Drought Conditions on Contaminant Migration from the Weldon Spring Quarry" which is enclosed with this letter.

The report indicates that short term changes in groundwater velocity and flow patterns due to increased pumpage and low river stages do not appear to have a measurable impact on contaminant migration. Any long term effects will be evaluated as part of the ongoing environmental monitoring program.

If you have any questions, please feel free to call.

Sincerely,

R. R. Nelson

R.R. Nelson
Project Manager
Weldon Spring Site
Remedial Action Project

Enclosure:
As stated

cc w/o enclosure:
W. F. Manning, CE-50
Honorable Gerald Ohlms, St. Charles County

ADDRESSEES FOR LETTER DATED NOVEMBER 17, 1988

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